Alaska Outer Continental Shelf

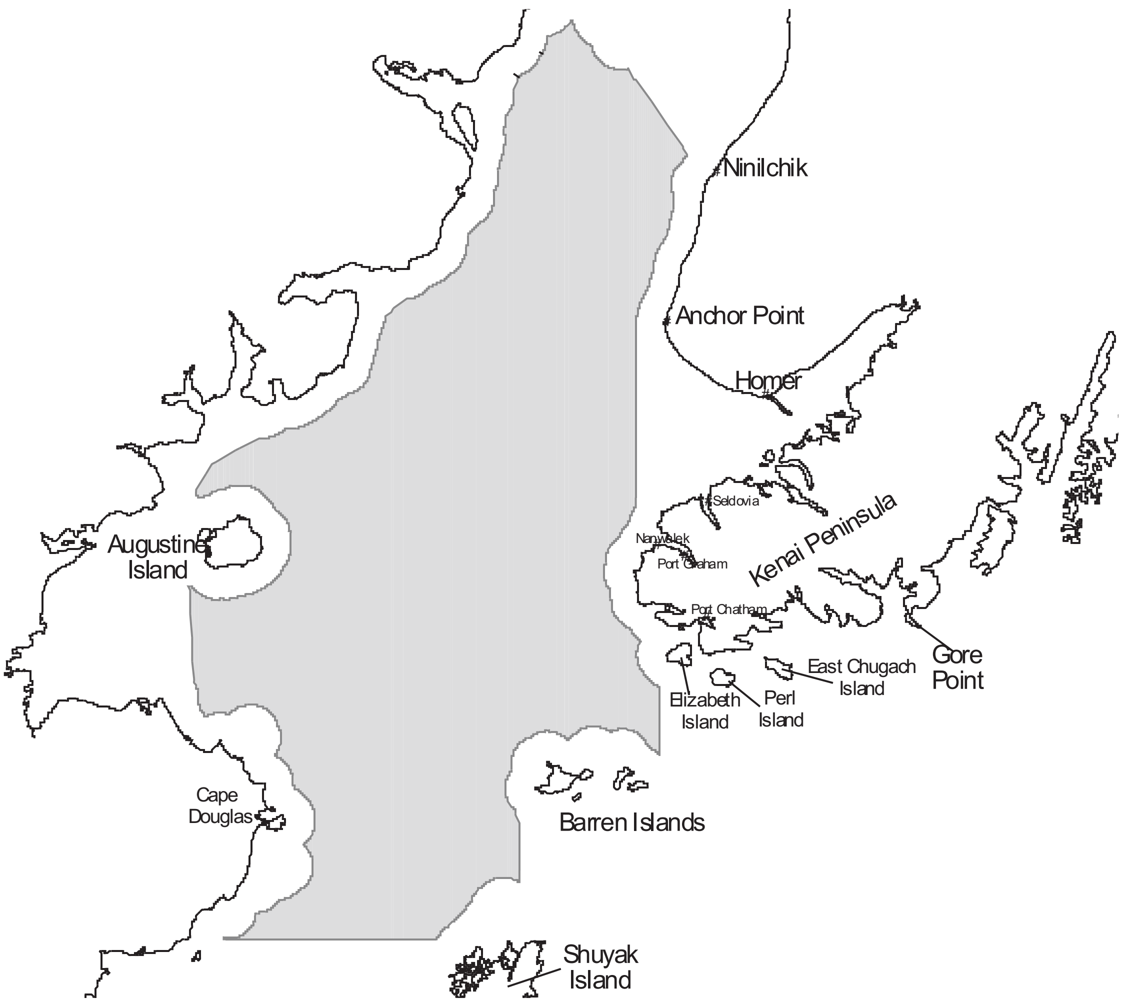
OCS EIS/EA
MMS 2003-055

Cook Inlet Planning Area

Oil and Gas Lease Sales 191 and 199

Final Environmental
Impact Statement

Volume I
(Executive Summary and Sections I through VI)



U.S. Department of the Interior
Minerals Management Service
Alaska OCS Region

COOK INLET PLANNING AREA OIL AND GAS LEASE SALES 191 AND 199
Final Environmental Impact Statement
OCS EIS/EA, MMS 2003-055, in 3 volumes:
Volume I, Executive Summary and Sections I through VI
Volume II, Section VII and Appendices
Volume III, Tables, Figures, Map, Bibliography and Index

The summary is also available as a separate document:
Executive Summary, **MMS 2003-056.**

The complete EIS is available on CD-ROM (**MMS 2003-055 CD**) and on the Internet (**http://www.mms.gov/alaska/cprojec/Cook _Inlet/Cook Inelt Sale.htm**).

This Environmental Impact Statement (EIS) is not intended, nor should it be used, as a local planning document by potentially affected communities. The exploration, development and production, and transportation scenarios described in this EIS represent best-estimate assumptions that serve as a basis for identifying characteristic activities and any resulting environmental effects. Several years will elapse before enough is known about potential local details of development to permit estimates suitable for local planning. These assumptions do not represent a Minerals Management Service recommendation, preference, or endorsement of any facility, site, or development plan. Local control of events may be exercised through planning, zoning, land ownership, and applicable State and local laws and regulations.

With reference to the extent of the Federal Government's jurisdiction of the offshore regions, the United States has not yet resolved some of its offshore boundaries with neighboring jurisdictions. For the purposes of the EIS, certain assumptions were made about the extent of areas believed subject to United States' jurisdiction. The offshore-boundary lines shown in the figures and graphics of this EIS are for purposes of illustration only; they do not necessarily reflect the position or views of the United States with respect to the location of international boundaries, convention lines, or the offshore boundaries between the United States and coastal states concerned. The United States expressly reserves its rights, and those of its nationals, in all areas in which the offshore-boundary dispute has not been resolved; and these illustrative lines are used without prejudice to such rights.

Alaska Outer Continental Shelf

OCS EIS/EA
MMS 2003-055

Cook Inlet Planning Area
Oil and Gas Lease Sales 191 and 199

Final Environmental
Impact Statement

Volume I
(Executive Summary and Sections I through VI)

Author
Minerals Management Service
Alaska OCS Region

U.S. Department of the Interior
Minerals Management Service
Alaska OCS Region

November 2003

Cover Sheet and Abstract

Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199
Environmental Impact Statement

Draft ( ) **Final (X)**

Type of Action: Administrative (X) Legislative ( )

Area of Proposed Effect: Offshore marine environment and the Cook Inlet area of Alaska

Responsible Agency: U.S. Department of the Interior
Minerals Management Service
Alaska OCS Region
949 East 36th Avenue
Anchorage, AK 99508-4302

Abstract: This environmental impact statement (EIS) assesses two lease sales in the Final 2002-2007 5-Year Oil and Gas Leasing Program for the Cook Inlet Outer Continental Shelf (OCS) Planning Area. The Department has scheduled Sale 191 for 2004 and Sale 199 for 2006. The proposed sales include consideration of 517 whole or partial lease blocks in the Cook Inlet Planning Area, covering about 2.5 million acres (1.01 million hectares).

The area considered for the Proposed Action (Alternative I) is located seaward of the State of Alaska submerged lands boundary in the Cook Inlet and extends from 3-30 miles in water depths ranging from 30 feet to more than 650 feet. For each alternative, the EIS evaluates the effects to the human, physical, and biological resources from routine activities and from the unlikely chance of a large oil spill. Other alternatives include Alternative II (No Lease Sale), which means cancellation of the sale; and two deferral alternatives (Alternatives III and IV), which would eliminate various subareas from leasing. A cumulative-effects analysis evaluates the environmental effects of the proposed action with past, present, and reasonably foreseeable future OCS lease sales, as well as non-OCS activities.

MMS evaluated four standard lease Stipulations and six standard Information to Lessee (ITL) clauses as part of the proposed action. The EIS also evaluates an optional ITL.

For further information regarding this EIS, contact:

Dr. James T. Lima
Minerals Management Service
949 East 36th Ave., Rm. 308
Anchorage, AK 99508-4302
(907) 271-6684

Dr. George Valiulis
U.S. Department of the Interior
Minerals Management Service
381 Elden Street (MS 4320)
Herndon, VA 20170-4817
(703) 787-1662

THE COOK INLET MUTIPLE SALE

FINAL EIS

WHAT IT INCLUDES

AND

HOW IT IS STRUCTURED

THE COOK INLET MULTIPLE-SALE EIS – WHAT IT INCLUDES AND HOW IT IS STRUCTURED

OVERVIEW AND GENERAL INFORMATION

These pages provide a quick overview of the contents and structure of this environmental impact statement (EIS). Because the EIS is somewhat complicated, we in the Minerals Management Service (MMS) urge you to read this first.

In June 2002, the Secretary of the Interior issued a Final 5-Year Offshore Oil and Gas Leasing Program for 2002-2007. It includes two lease sales on the Cook Inlet Outer Continental Shelf— Sale 191 scheduled in 2004 and Sale 199 in 2006. This multiple-sale EIS assesses environmental effects of these sales, both of which consider leasing the same geographical area in the Cook Inlet. As MMS begins preparations for Sale 199, we will do an Environmental Assessment (EA) to determine whether the EIS is still adequate or whether a supplemental EIS is needed. That EA will be available for public review and comment.

The MMS has successfully used offshore multiple-sale EIS's in the Gulf of Mexico Region. The National Environmental Policy Act (NEPA) encourages such an approach. It avoids publication of nearly duplicate documents and staff "burnout" in local, State, and Federal reviewing agencies and saves the MMS staff and financial resources. It also focuses readers on key environmental issues that are similar for each sale.

We use and cite the latest and best information available in this EIS. When information was limited, authors used their best professional judgment in describing effects.

This final EIS is available in paper copy and as a CD-ROM. The CD-ROM is convenient to use; has numerous hyperlinks; and saves substantially on paper, printing, and postage costs.

We organized this EIS as follows:

Executive Summary: This sets out the geographic scope and context of the proposed sales and then summarizes the issues raised in written and oral scoping comments. We present the assumed development scenario for purposes of analysis. We describe three groups of effects of the Proposed Action (Alternative I) for each sale: (1) effects from routine permitted activities, (2) effects from an unlikely large oil spill, and (3) cumulative effects.

The Executive Summary then summarizes the effects of No Lease Sale (Alternative II) and the effects of the two deferral alternatives: the Lower Kenai Peninsula Deferral (Alternative III) and the Barren Islands Deferral (Alternative IV). Finally, we address the mitigating measures assumed to be part of the proposed action and alternatives.

Section I - Purpose and Background of the Proposed Action: This section discusses the purpose, need, and description of the proposal for the two sales in addition to the legal mandates and a summary of the scoping process results.

We then describe four alternatives—the Proposed Action, no action, and two deferrals, all of which are the same for both sales. We identify an agency-preferred alternative for Lease Sale 191. Next is our rationale for not considering in further detail other issues from scoping and public comments on the Draft EIS. We then list the mitigation measures (both the Stipulations and Information to Lessees clauses) and summarize information on Indian Trust Resources and Environmental Justice. The section ends with a description of the NEPA process for the two sales and our effort to keep the EIS as concise as possible.

Section II - Alternatives, Including the Proposed Action: We describe in detail our analytical approach to assessing the hydrocarbon-resource potential of Cook Inlet and the development scenarios of offshore operational activities that we use to estimate environmental effects. We introduce the "Opportunity Index" to describe the risk-weighted probability of discovering and developing an economic field in the Cook Inlet.

We then describe in detail the four alternatives and the agency-preferred alternative, four Stipulations, six Standard ITL clauses, and one optional ITL clause.

Section III - Description of the Affected Environment: This section describes the physical characteristics, biological resources, social systems, and petroleum infrastructure of Cook Inlet.

Section IV - Environmental Consequences: This section contains the heart of the EIS. We begin with detailed information on all the basic assumptions used in our assessment of effects. Next, we describe the positive and negatives effects of taking no action (Alternative II). We address in 19 resource categories the bulk of the analysis of effects in this section.

- Water Quality
- Air Quality
- Lower Trophic-Level Organisms
- Fisheries Resources
- Essential Fish Habitat
- Endangered and Threatened Species
- Marine and Coastal Birds
- Nonendangered Marine Mammals
- Terrestrial Mammals
- Economy
- Commercial Fishing
- Subsistence-Harvest Patterns
- Sociocultural Systems
- Recreation, Tourism, and Visual Resources
- Sportfishing
- Archaeology Resources
- National and State Parks and Special Areas
- Coastal Zone Management
- Environmental Justice

Under most of the above categories, we first present the effects of Sale 191 from permitted activities, including effects of noise and disturbance, the general effects of small oil spills, and the effects of an unlikely large spill with associated cleanup activities. We then analyze the effects on the particular resource category of each alternative. We also identify the differences, if any, between the effects of Sale 191 and the effects of Sale 199. We treat a few categories, such as Economy and Environmental Justice, somewhat differently.

We end the section with an analysis of topics required by the National Environmental Policy Act and the effects to resources from a very large, but extremely unlikely, blowout oil spill.

Section V - Cumulative Effects: This section presents the approach used in analyzing cumulative effects, then details the past, present, and reasonably foreseeable activities that contribute to cumulative effects. The bulk of the analysis is cumulative effects by resource. We assess the cumulative effects on the 19 previously mentioned resource categories and end each subsection with a statement of the contribution that the Proposed Action for Sale 191 makes to the cumulative effects.

Section VI - Consultation and Coordination: Here we include organizations and individuals with whom we consulted, who provided written or oral scoping comments, or who are on our mailing list. We also include a list of contributing authors and support staff.

Section VII - Review and Analysis of Comments Received: This section provides copies of the comments we received by letter, e-mail, or as testimony at the hearings. We have assigned a number to each document from 001 through 0122. Within each document, we identify the comments requiring a response. The combination of the document number and comment number provides a unique identifier for each comment. The responses to comments immediately follow each document. Duplicative e-mails and letters consequently include representative examples.

Appendices: Appendices include technical information on oil spills, resource estimates, the Endangered Species Act consultation, Essential Fish Habitat consultation, other applicable laws and regulations, and the Scoping Report.

Information on Alternatives: This EIS contains an extensive analysis of the potential effects of the Proposed Action (Alternative I), No Action (Alternative II), the Lower Kenai Peninsula Deferral (Alternative III) and the Barren Islands Deferral (Alternative IV).

In addition, the EIS identifies an agency-preferred alternative that is a combination of the Lower Kenai Peninsula Deferral (Alternative III) and the Barren Islands Deferral (Alternative IV), which includes four Stipulations, six Standard ITL clauses, and one optional ITL clause.

The following sections of the EIS present information on these Alternatives:

	Proposed Action Alternative I	Lower Kenai Peninsula Deferral Alternative III	Barren Islands Deferral Alternative IV	Agency-Proposed Alternative
Description of Alternative	Section I.C.2.a(1) Section II.B	Section I.C.2.a(3) Section II.C	Section I.C.2.a(4) Section II.D	Section I.C.2.a(5) Section II.G
Analysis of Effects	Section IV.B.1	Section IV.B.3	Section IV.B.4	Section IV.B.3 and Section IV.B.4
Summary of Effects	Table II.B-2 (column 2)	Table II.B-2 (column 3)	Table II.B-2 (column 4)	Table II.B-3
Area offered for leasing/deferral	Figure I.A-1 Table I.A-1	Figure I.A-1 Table I.A-1	Figure I.A-1 Table I.A-1	Figure I.A-2 Table I.A-1

Please note that for the agency-preferred alternative, we do not provide a separate analysis of the effects, because it would repeat the information provided for Alternative III (Section IV.B.3.) and Alternative IV (Section IV.B.4). However, we have summarized the effects of the agency-preferred alternative in a separate table so the reader will not have to interpolate the information in Table II.B-2 column 2, 3, and 4 in order to grasp the essential effects of the agency-preferred alternative.

Other Uses of the Document: Under NEPA, the analysis in the EIS identifies potential adverse and beneficial effects from the proposed action. We classify some of these effects as "significant" when they exceed the thresholds listed for each resource category in Section IV.A.1 of the EIS. In doing so, the EIS stands on its own as an analytical document which fully informs decisionmakers and the public of the environmental effects of the proposed action and those of the reasonable alternatives.

To reduce duplication and paperwork, we prepared an environmental document in compliance with the NEPA and in consultation with other Federal and State agencies. We use this EIS to provide information on potential adverse effects from the Proposed Action to endangered and threatened species, essential fish habitat, and archaeological resources, each of which has consultation requirements. Please note that the definition of "adverse effect" for these three areas may differ from the definition we use for classifying an adverse effect as "significant" in our NEPA analysis.

For example, the EIS also serves as our biological evaluation of potential likely adverse effects to endangered and threatened species and designated critical habitat in the proposed action. This information is within the Endangered and Threatened Species section in the description of the affected environment (Section III), environmental consequences (Section IV), and the cumulative effects (Section V). This biological evaluation provides the basis of our consultation with the National Marine Fisheries Service and the Fish and Wildlife Service. As a result of the consultation, these agencies issue a biological opinion that evaluates whether or not the potential likely effects from the Proposed Action place an endangered or threatened species in jeopardy and identify measures to mitigate the effects. (Appendix D contains the biological opinions from these agencies.) Section III.B.4.a provides a detailed overview of the requirements for evaluation of potential likely adverse effects to endangered and threatened species.

The EIS also serves as our Essential Fish Habitat analysis and contains the information required under 50 CFR 600.920 (e)(3) that must be submitted to NOAA Fisheries:

Description of the Action: Section I.A describes the Proposed Action, Section I.C.2., the alternatives, and Section I.C.3 identifies mitigation measures assumed to be part of the Proposed Action and alternatives. Section II describes each of these alternatives, mitigating measures, and information to lessee clauses in greater detail and also presents a hypothetical exploration, development, and production scenario that provides the basis for the analysis of effects from the proposed action and alternatives.

The Potential Adverse Effects of the Proposed Action on Essential Fish Habitat and the Managed Species: Section III.B.3 identifies and describes the essential fish habitat that could potentially be affected by the Proposed Action. Section IV.B.1.e presents analysis of the potential adverse effects of the Proposed Action on essential fish habitat. Section IV.B.1.a discusses water quality alteration, and Section IV.B.1.b discusses atmospheric depositions which could affect essential fish habitat. The EIS includes analysis of alternatives to the action that could avoid or minimize adverse effects on essential fish habitat by eliminating portions of the leasing area. Sections IV.B.3.b(4) and IV.B.4.b(4) present analysis for the potential effects on essential fish habitat from the Lower Kenai Peninsula Deferral (Alternative III) and the Barren Islands Deferral (Alternative IV), respectively.

The MMS presents conclusions on the effects of the proposed action on essential fish habitat in Section IV.B.1.e(1).

ABBREVIATIONS,
ACRONYMS,
SYMBOLS,
AND CONVERSION FACTORS

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

AAC	Alaska Administrative Code
B.P.	Before Present
AMSA	Area Meriting Special Attention
ARRT	Alaska Regional Response Team
Bcf	Billion cubic feet
BLM	Bureau of Land Management
C	Carbon
CD	Consistency Determination
Call	Call for Information and Nominations
CFR	Code of Federal Regulations
COST	Continental Offshore Stratigraphic Test (well)
CZMA	Coastal Zone Management Act
DPP	Development and Production Plan
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EP	Exploration Plan
ENRI	Environmental and Natural Resources Institute
EPA	Environmental Protection Agency
ERA	Environmental Resource Area
ESA	Endangered Species Act
et seq.	and the following
FONSI	Finding of No Significance Impact
FR	*Federal Register*
i.e.	that is
ITL	Information to Lessees (clause)
LA	Launch Area
LC_{50}	lethal concentration at which 50% of the organisms die
LS	Land Segment
MMS	Minerals Management Service
Mmbbl	Millions of barrels
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
NOI	Notice of Intent to prepare an EIS
NOAA	National Oceanographic and Atmospheric Administration
NORM	naturally occurring radioactive materials
NPDES	National Pollutant Discharge Elimination System
NTL	Notice to Lessees
OCS	Outer Continental Shelf
OGCC	Oil and Gas Conservation Commission
P	Pipeline
P.L.	Public Law

pH	measure of acidity in water
PM-10	particulate matter less than 10 microns in diameter
PSD	Prevention of Significant Deterioration (Program)
ROD	Record of Decision
RSFO	Regional Supervisor, Field Operations
SHPO	State Historic Preservation Officer
TAPS	Trans-Alaska Pipeline System
U.S.	United States
U.S.C.	United States Code
UAA	University of Alaska Anchorage
USDOC	U.S. Department of Commerce
USDOI	U.S. Department of the Interior
_	statistical mean
%	percent
°	degree

A glossary of terms used by MMS and oil/gas industry is available at http://www.mms.gov/glossary/index.htm

CONVERSION FACTORS

Metric	=	English
1 kilometer	=	0.621 mile (statute)
	=	0.540 mile (nautical)
1 meter	=	0.54681 fathoms
1 square meter	=	10.76 square feet
	=	1,196 square yards
1 hectare	=	2.471 acres
1 square kilometer	=	0.386 square miles
1 cubic meter	=	35.314 cubic feet
	=	1.31 cubic yards
1 liter	=	0.264 gallons
	=	0.00628 barrels (1 barrel = 42 gallons)
1 kilogram	=	2.20 pounds
1 metric ton (1000 kg)	=	1.10 ton
	=	0.9842 long ton

EXECUTIVE SUMMARY

Contents of the Executive Summary

Executive Summary: Cook Inlet Environmental Impact Statement for Lease Sales 191 and 199

A. INTRODUCTION AND BACKGROUND

This environmental impact statement (EIS) assesses two lease sales in the 2002-2007 Five-Year Oil and Gas Leasing Program for the Cook Inlet Outer Continental Shelf (OCS) Planning Area. Sale 191 is scheduled for 2004 and Sale 199 for 2006. Federal regulations (40 CFR 1502.4) suggest analyzing similar activities in a single EIS. However, a separate decision will be made on whether to proceed with each sale. If the Secretary of the Interior decides to proceed with each of the sales (191 and 199) by not choosing Alternative II - No Lease Sale, the Secretary may chose one, all, some combination, or any part of the alternatives to comprise the Final Notice of Sale for Sale 191. The Secretary will have the full suite of options available for Sale 199 when that decision is made in 2006. The Secretary may choose the same options selected for Sale 191 or different options.

The proposal for each sale is to offer for leasing 517 whole or partial lease blocks in the Cook Inlet OCS Planning Area, an area encompassing approximately 2.5 million acres (1.012 million hectares) (see Figure I.A-1 and Table I.A-1). The proposed sale area is seaward of the State of Alaska submerged lands boundary in Cook Inlet and extends from 3-30 miles offshore from Kalgin Island south to near Shuyak Island. The proposed sale area excludes Shelikof Strait. Although water depths may exceed 650 feet, the Minerals Management Service (MMS) expects most, if not all, exploration and development activities will take place in shallower water. For purposes of analysis, we assume that 140 million barrels of oil and 190 billion cubic feet of natural gas could be discovered and produced from a single development as a result of either or both sales. Only a small percentage of the blocks available for lease under the Proposed Action for Sales 191 and 199 likely would be leased. Of the blocks that would be leased, only a portion would be drilled. Of these, only a very small portion, if any, likely would result in production.

B. SCOPING AND DRAFT EIS PUBLIC COMMENT

Scoping is the ongoing public process to identify issues for in-depth analysis in the EIS. We held public scoping meetings in Homer, Seldovia, Ninilchik, Kenai, Kodiak, and Anchorage. We received both oral and written comments from constituents. Commenters included affected local, tribal, State, and Federal agencies; the petroleum industry; Native groups; environmental and public interest groups; and concerned individuals. The input we received from these sources aided us in identifying significant issues, possible alternatives, and potential mitigating measures. As part of our local scoping process, we held government-to-government dialogues with Native groups, both in formal agency meetings and in open public forums. This EIS addresses Environmental Justice and Government-to-Government coordination.

The scoping comments identified the following major issues:

- Water quality from discharge of drilling fluids and cuttings,

- Subsistence-harvest patterns,
- Habitat disturbances and alterations,
- Accidental oil spills,
- Commercial and recreational fishing, and
- Socioeconomics.

We address these and other issues raised in scoping throughout this EIS.

We received approximately 2,000 written comments on the draft EIS during the public comment period from December 13, 2002, to February 11, 2003. We received letters, emails, and postcards from a wide spectrum of the population, most originating from within Alaska or other parts of the United States. Approximately 93 persons testified at the five court-reporter-recorded public hearings held in January 2003 in Anchorage, Seldovia, Homer, Kenai-Soldotna, and by telephone. We held four government-to-government meetings with Native communities.

Most commenters voiced a preference for Alternative II - No Lease Sale. These commenters suggested that the national energy policy should shift away from fossil fuels and instead emphasize conservation and alternative energy sources. Many commenters felt that leasing in lower Cook Inlet was not compatible with the ecological, economic, and social values of the area, including Native subsistence culture and lifestyle. Many commenters expressed concern about the effects of an oil spill. Commenters expressing a preference for Alternative I, III, or IV often cited the need to develop additional energy sources to sustain the local economy and attendant sociocultural institutions.

We identified the agency-preferred alternative in the final EIS. As a result of our review and response to the public comments on the draft EIS, the alternatives analyzed in the final EIS stayed the same. We added summaries of government-to-government meetings with directly affected tribes. Information to Lessees No. 7 - Air Quality Regulations and Standards was added to address concerns about potential air quality effects to the Tuxedni National Wilderness Area, and information on air quality monitoring was added as Appendix H. Text revisions focused on major issues dealing with potential effects of onshore pipeline construction and oil spills, and coastal and marine birds, fisheries resources, essential fish habitat, and commercial fishing. These sections incorporated additional information. Where comments warranted other changes or presentation of additional information, revisions were made to the appropriate text in the final EIS.

C. HYPOTHETICAL DEVELOPMENT SCENARIO FOR EACH SALE

For purposes of analysis, we assume exploration would follow from both Sales 191 and 199. The hypothetical scenario envisions the drilling of two exploration wells on tracts leased in Sale 191 and two exploration wells on tracts leased in Sale 199. We assume a single discovery could result from the exploration activities of either or both sales as the basis for analyzing effects from development. Three delineation wells would be drilled to define the boundaries of the field. Development and production activities could then commence from a single platform, with transport of production by pipeline to existing facilities on the Kenai Peninsula for processing and distribution. Table II.B-1 identifies the exploration and development and production activities for the hypothetical scenario, which anticipates that the field would produce approximately 140 million barrels of crude oil and 190 billion cubic feet of natural gas, and that all production would be used in the Cook Inlet area. As such, we foresee no tankering of Cook Inlet OCS production, and that Cook Inlet OCS production would offset importation of petroleum by tanker from other sources, such as Trans-Alaskan Pipeline System crude oil.

The locations of undiscovered commercial offshore oil and gas fields are impossible to predict without exploration drilling. Petroleum-assessment models statistically analyze the geology and engineering characteristics of the area to determine the total resource volume that we expect to be economically viable to produce if discovered. While these total resource estimates are valid on a regional scale, they cannot be subdivided into smaller fractions and still be meaningful as likely volumes. However, we use a risk-weighting method to define the chance that the resource volume will occur in a particular subarea.

We use the term "Opportunity Index" to describe that risk-weighted probability. To understand the index, suppose, for example, that an OCS area contained a total of 500 million barrels of economically recoverable oil in any of five prospects. Also suppose that each prospect is the same size and equally likely to contain recoverable oil. The risk-weighted volume assigned to each prospect would be 100 million barrels. The Opportunity Index assigned to each prospect would be 20%. This means that there is a 20% chance (or 1-in-5 chance) that 500 million barrels could be discovered in any single prospect, but the others would be dry. If a deferral option removed two of the five prospects, we would not subtract 200 million barrels from the total but would lose 40% of the opportunity to discover the 500 million barrels.

Outputs from geologic and economic assessment models based on currently available data define the Opportunity Index. These models assume that leasing, exploration, and development are not restricted by regulations or industry funding. In reality, access to untested tracts and exploration budgets constitute key determinants of the level of industry interest in an area. Oil prices and government regulations also are key determinants. Low oil prices and overly restrictive regulations could lessen industry interest in an area despite its high geologic potential. Future oil prices and future corporate strategies for leasing are impossible to predict accurately. We can base our analysis of resource potential only on past leasing trends and petroleum assessments using current data. Each company may have a very different perspective of the development potential of an area such as Cook Inlet. The key concept is that industry will only bid on tracts that they believe have some chance of becoming viable oil and gas fields. Notwithstanding the value of the Opportunity Index in understanding how to think about the likelihood of finding oil and gas resources, we caution the reader to exercise care in drawing conclusions about the Opportunity Index in relation to the Alternatives III and IV, which follow.

The MMS is considering offering suspension of royalties on initial volumes of oil from new production. Given that development occurs from newly offered tracts, these suspensions would not be expected to change the resource estimates that provide the basis for the hypothetical scenario used to analyze environmental effects of the Proposed Action. We believe that the assumed scenario discussed in the EIS is more likely to occur with the new incentives than without them. Without the leasing incentives, the assumed development scenario would be less likely to occur and the present situation of little leasing and exploration likely would continue into the future.

The assumed development scenario generated for environmental analysis purposes is optimistic compared to historical trends. An optimistic development scenario ensures that the environmental analysis covers the potential effects at the high end of possible petroleum activity levels including those that could occur as a result of any increase in activities as a result of incentives. Without incentives, the proposed OCS sale could still result in leasing and exploration, however; under such conditions we anticipate minimal industry interest in offshore development because of the marginal economic viability of oil discoveries in difficult locations. With incentives, offshore development activities are more likely to approach the levels analyzed in the EIS.

D. ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION (ALTERNATIVE I) FOR LEASE SALES 191 AND 199

D.1. Effects from Routine Activities

If we hold either or both of the lease sales and exploration and development follows, the associated industrial activities could generate some degree of disturbance, noise, and discharges into the environment. The EIS analysis found no potential significant effects from the anticipated routine, permitted activities. Furthermore, the EIS found that Cook Inlet resources likely would experience fewer exploration effects if only one sale were held, but the same level of effects from development.

Potential effects from either or both sales would not cause any overall measurable degradation to Cook Inlet **water quality**. Effects to **air quality** from emissions would cause only small, local, and temporary increases in the concentration of criteria pollutants but would not cause ambient air-quality standards to be exceeded. Effects to **lower trophic-level organisms** from disturbance caused by drilling platform emplacement and other effects from other routine operations would not have measurable effects on local populations. No measurable effect on **fisheries resources** would be likely. Although some individual fish could be affected during construction and drilling activities, most fish in the immediate area would avoid these activities and would be otherwise unaffected. Seismic surveys, turbidity, and pipeline construction (both offshore and onshore) could cause adverse effects to **essential fish habitat**; however, the magnitude of impacts are considered low and are not expected to result in measurable effects at the regional ecosystem level.

Local effects could result to **endangered species** near noise and other disturbance caused by exploration, development, and production activities and disturbance from aircraft and vessels. For example, in specific areas, particularly near the Barren Islands, these disturbances could affect behavior of Steller sea lions and haulouts; cause local, short-term effects on the feeding of humpback whales in the Kennedy and Stevenson entrances; and locally affect some Cook Inlet beluga whales. Behavior of sea otters could be affected and some displacement of sea otters could occur near areas of activity. Although small numbers of individuals could be affected, regional population or migrant populations of **nonendangered marine mammals, terrestrial mammals** (brown bears, river otters, Sitka black-tailed deer, and others)**,** and **marine and coastal birds** would experience no measurable effect from disturbance and habitat alteration.

Measurable effects to **commercial fishing** or **sport fishing** are not expected to result from the seismic surveys that would be planned and coordinated with the fishing industry, limited drilling discharges, small oil spills, and space-use conflicts from construction activity that are few in number and minor in scope. Short-term, local disturbance could affect **subsistence-harvest resources**, but no resource or harvest area likely would become unavailable, and no resource population would experience an overall decrease. Construction disturbance temporarily could displace a few individuals of subsistence species.

Sociocultural systems would not be altered, because the sales and possible follow-on activities would result in few new residents. Furthermore, the activities represent the continuation of an important and long-time aspect of many of the area's communities. Effects to **recreation and tourism** from space-use conflicts would be rare and short lived. No effects to **visual resources** are expected from the presence of offshore platforms. No "disproportionately high adverse effects" as defined by the **Environmental Justice** Executive Order are expected to occur from planned and permitted activities associated with either of the sales evaluated in this EIS. Disturbance of historic and prehistoric **archaeological resources** is possible, but not likely, during exploration and development activities both onshore and offshore. In addition, terrestrial and marine archaeological surveys would identify any potential resources prior to activities taking place, and the sites would be avoided or the effects mitigated.

Based on the assumed discovery and development of 140 million barrels of oil and 190 billion cubic feet of natural gas, some **economic** benefits could occur to the State of Alaska and the Kenai Peninsula Borough. No conflicts are anticipated with the Statewide standards of the Alaska **Coastal Management** Plan or the enforceable policies of the Kenai Peninsula Borough or the Lake and Peninsula Borough.

D.2. Effects in the Unlikely Event of a Large Oil Spill

Over the life of the hypothetical development and production that could follow from either or both of the lease sales, other effects are possible from unlikely events, such as a large, accidental oil spill or natural gas release. We estimate the mean number of one or more spills greater than or equal to 1,000 barrels is 0.16 for either of the proposed sales. The chance of a large spill greater than or equal to 1,000 barrels occurring and entering offshore waters is 19%. For purposes of analysis, we model one large spill of either 1,500 barrels (platform spill) or 4,600 barrels (pipeline spill). The low probability of such an event, combined with the characteristics of the resources inhabiting the area (for example, they may be present in parts of the area during different times of the year), make it unlikely that a large oil spill would occur and contact these resources.

However, if an unlikely large spill were to occur, the analysis identified potentially significant impacts to the Southwest Alaska stock of sea otters and Steller sea lions, essential fish habitat, commercial fisheries, sport fisheries, recreation and tourism, archaeological sites, and State and national parks. The realization of these impacts depends on species being in the relatively small area affected by the unlikely spill, closure of the commercial fishery because of the spill, or contact by the oil in areas where sport fishing, recreation and tourism, and archaeology resources occur. For example, for significant effects to take place to recreation, a spill has to occur between May and September (the high-use season), recreation areas must be contacted, and the contact must result in complete or partial closure of access that exceeds a certain period of time. Evaluation of significance is done without regards to the effect of mitigating measures. However, the geographic response strategy for oil spills employed by Cook Inlet Spill Prevention and Response Inc. calls for measures to be employed to protect high-value resource areas (including recreation areas) in the unlikely event of a spill.

Water quality would be temporarily degraded with the concentration of hydrocarbons in water less than the acute pollution criterion within 3 days of the spill, while concentration above the chronic criterion would last less than 30 days. Concentration of criterion pollutants for **air quality** would remain well within Federal air quality limits with minimal effects to air quality. In the affected area of an oil spill, approximately 17-38 kilometers of shoreline could be contaminated; populations of intertidal **lower trophic-level organisms** in these areas could be depressed measurably for about a year, and small amounts of oil would persist in the habitat for a decade.

While we expect no measurable loss to **fisheries resources** at the population level**,** a potential loss could occur to some adult demersal fish with increased mortality to eggs and fry of pink salmon, semidemersal fish, and loss of some demersal fish. While we estimate that effects to estuarine and marine **essential fish habitat** generally would be low because localized fish habitat would be expected to recover within months to years, effects on beach and intertidal fish habitats could be considered locally significant, because oil could remain in the small areas or prey could be impacted for more than a decade. Adverse but not significant effects (as defined under the National Environmental Policy Act) to **endangered and threatened species** usually would occur only when the species is present in the small area that would be affected at the time the unlikely spill occurs. For example, if an unlikely spill occurred in the southern lower Cook Inlet and entered the Shelikof Strait or Kachemak Bay from summer to late autumn adverse effects to humpback whales are estimated to be local and not-have population-level effects. Fin whales are vulnerable only if the unlikely spill entered the Shelikof Strait. Beluga whales could be susceptible, particularly if a spill occurs and enters the lower Cook Inlet during nonsummer months. (Evidence indicates Cook Inlet belugas have not suffered any harm from previous oil spills in Cook Inlet.) Some Steller's eiders of the Alaskan breeding population could be affected if an unlikely spill occurred from late autumn to early spring. Potentially significant effects to sea otters from the Southwest Alaska stock and Steller sea lions (particularly from the western population) could occur from such a spill, with mortality varying widely depending on which areas were oiled and where the otters or sea lions were distributed at the time of the spill. However, while the vulnerability of sea otters to oil spills is clear, the level of vulnerability of Steller sea lions is less certain.

Marine and coastal bird mortality could range from hundreds to tens of thousands, depending on the size, timing, and movement of the spill in relation to seasonal patterns of bird abundance and movement. Recovery for most species from these losses would take from 1 year to two or more generations.

Small numbers of resident **nonendangered marine mammals** could be lost—perhaps 20-100 harbor seals, a few fur seals, and 10-20 cetaceans—with total recovery from these losses taking place within 1-5 years. No measurable effects to regional or migratory populations of marine mammals within the Cook Inlet area are expected to occur. The estimated likely loss of **terrestrial mammals** could be 10-30 river otters and brown bears and fewer than 100 Sitka black-tailed deer, with recovery expected within 1-3 years. Regional populations of terrestrial mammals likely would not be affected.

A large oil spill likely could affect the local **economy** and create additional employment of 60-190 jobs for up to 6 months. The **commercial fisheries** in Cook Inlet and possibly Kodiak Island/Shelikof Straight could be affected depending on time, size, and location of the spill. For example, if a 4,600-barrel spill in the spring causes the State to close the fishery because of tainting concerns, the loss could be in excess of 22% of the average annual value of the commercial fishery for 2 years. It is possible that the spill could close the fishery for a whole season, resulting in a 100% loss for that year, and this would be a significant effect. **Sport fisheries** could be similarly affected with a loss of 20%. An unlikely spill would have to contact the popular clam- and other shellfish-gathering areas within Cook Inlet and result in the decline of the population of intertidal organisms for 1 year, with oil in shoreline sediments for up to 10 years, for a significant effect to occur. The **subsistence resources,** including harvest areas and harvest patterns in traditional communities, could be affected for at least one harvest season or longer, with tainting concerns among consumers possibly making an even larger array of resources unavailable for use. Effects from an unlikely large oil spill would not be of a size that would displace or alter the fundamental long-term relationship between subsistence harvest and

sociocultural systems, although these systems could be adversely affected by tainting concerns. As such, sociocultural systems of Native Alaskan villages should not be affected in the unlikely event a large spill. Under **Environmental Justice**, a disproportionate high adverse effect on Native Alaskans could result from the combination of an unlikely large spill contaminating essential subsistence-harvest areas, cleanup effects further damaging those resources, tainting concerns altering consumption of those resources, and disruption of subsistence practices as a result of the contamination. The sociocultural systems of towns and cities should not be affected by an unlikely large oil spill. Locally significant effects could occur to coastal-dependent and coastal-enhanced **recreation and tourism** areas, if they are contacted and completely or partially closed by the spill. Oil contamination and spill-cleanup activities that disturb significant **archaeological** resources that may be present in the area could result in potentially significant impacts. An unlikely large oil spill also could have a significant effect on the intrinsic values of **national and State parks** and other designated management units in the area of the spill. No adverse effects are anticipated to **coastal management;** the Statewide standards of the Alaska Coastal Management Plan; or the enforceable policies of the Kenai Peninsula, Lake and Peninsula, or Kodiak Boroughs.

The EIS also considers a release of 10 million cubic feet of natural gas lasting 1 day. A few local effects to some resources, but no significant effects, were found to result from the large natural gas release.

In summary, while a large oil spill could cause some adverse effects and a very limited number of potentially significant effects, we do not expect these effects to occur, because it is unlikely that a large oil spill would occur. Furthermore, an area affected by such a spill relative to the size of Cook Inlet decreases the likelihood that the resources would be widely contacted by the spill.

D.3. CumulativeEffects

We do not expect any significant cumulative impacts to result from any of the routine activities associated with Alternative I for Sale 191. For the cumulative analysis in this EIS, we estimate that the effects of the other alternatives (Alternatives III and IV) for Sale 191, if chosen, and for Sale 199 and its alternatives would be essentially the same as those for Alternative I for Sale 191. In the cumulative-effects analysis, we assess the estimated contribution of Sale 191 to the combined estimated additive, countervailing, and synergistic effects of all the past, present, and reasonably foreseeable activities that are likely to affect the same resources that may be affected by Sale 191. The differences in effects between the proposed sales and their alternatives are so small that we cannot distinguish measurable differences between the combined estimated effects in the cumulative case analysis.

If the routine activities associated with scenarios developed for Alternative I for Sale 191 occurred, the incremental contribution from the activities to the cumulative effects likely would be quite small. We estimate the activities would contribute approximately 7% of the cumulative effects in Cook Inlet from offshore oil exploration and development, based on the estimated production from the sale compared to the total estimated Cook Inlet basin past, present, and reasonably foreseeable future production. The analysis did find potential significant local cumulative effects to some **fish** from commercial overharvesting, **marine and coastal birds** from a variety of sources, **terrestrial mammals** primarily from commercial logging, and **archaeological resources** (if significant resources are affected) from onshore development. In the unlikely event a large or very large oil spill occurred and contacted resources, significant cumulative effects could be experienced. For biological resources, effects on **marine and coastal birds** would be through increased recovery time. For beach and intertidal **essential fish** habitat, effects would be from the persistence of oil. For **endangered and threatened species**, effects would be from spill contact to Steller sea lions and their critical habitat, sea otters, or Steller’s eiders. In the unlikely event a large or very large oil spill occurred and contacted social-system resources, significant cumulative effects could be experienced. For **subsistence-harvest resources** and the linked **sociocultural systems** and **Environmental Justice,** effects would result from spill contact to subsistence resources, cleanup activities, and the fear that resources were tainted. **Tourism and recreation** activities would be curtailed in the contacted area. There could be losses from the closure of **commercial-fishing** areas because of tainting concerns, and **sport fishing** would be affected by the curtailment of clam gathering in the contacted area. Significant damage could occur to **archaeological resources** from contact or cleanup activities, and there could be the perception of degradation to **national and State parks** in the area of the spill.

E. EFFECTS OF ALTERNATIVES II THROUGH IV

In addition to the No Lease Sale Alternative (Alternative II), two deferral alternatives were identified during the scoping process for analysis in the EIS. These alternatives are evaluated as options for each of the two proposed sales (191 and 199). Although Alternatives III and IV provide limited protection to resources that could be affected by oil and gas activity in the deferral areas, the deferrals do not change the estimated significant adverse effects identified in this Executive Summary for any of the sales.

Alternative II (No Lease Sale) equals cancellation of Sale 191, Sale 199, or both sales. Several individuals suggested this alternative during scoping. If Sales 191 and 199 are cancelled, neither the estimated possible oil and gas production nor the potential environmental effects resulting from the Proposed Action would occur. From a regional perspective, canceling both sales would provide some protection to the environmental resources in the Cook Inlet but likely would not completely eliminate the environmental impacts. The hypothetical scenario assumes that production from the Cook Inlet OCS would not be tankered but would be processed and used in the Cook Inlet area. The production from the Cook Inlet OCS would displace oil currently imported by tanker to Cook Inlet area processing facilities. Without the OCS production, importation of oil by tanker, with its attendant environmental risks, would continue and possibly increase. The natural gas production would help ensure an adequate supply to local consumers. In addition, substantial economic benefits would be lost if we cancel both sales. We estimate that the Kenai Peninsula Borough would not realize about $2.8 million per year in property tax revenue for 15 years. The State of Alaska would lose about $2 million per year for 15 years. During 5 years of exploration, 40 direct, indirect, and induced jobs and $2.8 million in personal income per year would be lost in the Borough. During 6 years of development, 330 direct, indirect, and induced jobs and $20.4 million in personal income per year would be lost. During 15 years of production, 100 direct, indirect, and induced jobs and $20.4 million in personal income per year would be lost. Comparable figures for the rest of Alaska are 70 total jobs and $4.1 million personal income per year during development and 20 total jobs and $1.2 million personal income.

From a global perspective, assuming that the amount of oil resources used in the U.S. continues at current rates, oil production in foreign countries would need to increase, with increased transportation by tanker to the U.S. Therefore, if both sales are cancelled, the environmental consequences described under Alternative I would not occur in Cook Inlet, but the production and transportation of the replacement oil would cause a variety of environmental consequences elsewhere. Imported oil imposes negative environmental impacts in producing countries and in countries along transportation routes. By not producing our own domestic oil and gas resources and relying on imported oil we are, from a global perspective at least, exporting a sizeable portion of the environmental impacts to those countries from which the U.S. imports oil and through or by which our imported oil is transported. This same transfer of environmental consequences holds true for any oil not produced, if either or both of the deferral alternatives are chosen.

If either Sale 191 or 199 is cancelled, the effects from the remaining sale would be essentially the same as described in Alternative I. The difference in the estimated level of activity described in the hypothetical scenario between holding both lease sales and holding only one lease sale is the drilling of two exploration wells and the information about oil and gas deposits that those two wells provide. If only Sale 191 is held, the activities would commence in 2005. If only Sale 199 is held, the activities would commence in 2007. The MMS would prepare an Environmental Assessment or supplemental EIS for Sale 199 to evaluate the effects of that sale. For example, the Environmental Assessment or supplemental EIS would evaluate the effects of the Proposed Action for any changes that may have occurred in the status, distribution, or abundance of endangered and threatened species.

Alternative III (Lower Kenai Peninsula Deferral) would defer offering 34 whole or partial blocks located in the southeast portion of Cook Inlet, with 483 whole or partial blocks (approximately 2.3 million acres) available for leasing (see Table I.A-1 and Figure I.A-1). The MMS developed this alternative based on analysis of areas offered for leasing in Sale 149 (for example, the Kennedy Entrance Deferral), location of critical habitat for the endangered Steller sea lion, and in response to comments received during scoping. In part, this deferral was developed as a potential way to reduce conflicts between subsistence users and offshore oil and gas operations based on input from the Native Village of Port Graham and others and analysis of subsistence resource use patterns. The EIS analysis concluded that the deferral would reduce potential impacts to **endangered and threatened species** including the beluga whale, Steller sea lions, sea otters, and humpback whales; reduce threats to marine and coastal birds because of their concentration in the deferral area; reduce **visual resource** effects by moving the potential platform locations further offshore; and protect possible unidentified historic **archaeological resources** that may be present in the deferral area. The EIS analysis concludes that for most resources, while the alternative would provide a measure of protection to the resources within the deferral area, the effects to the resources in the Cook Inlet area under this alternative would be essentially the same as the effects under Alternative I. As shown by the Lost Opportunity column in Table I.A-1, this deferral reduces by approximately 1% the Opportunity Index; that is, the chance to discover and develop an economic oil field from the sale.

Alternative IV (Barren Islands Deferral) would defer offering 36 whole or partial blocks located around the Barren Islands and Kennedy Entrance, with 481 whole or partial blocks (about 2.34 million acres) remaining available for leasing (see Table I.A-1 and Figure I.A-1). The MMS developed this alternative based on analysis of areas offered for leasing in Sale 149 (for example, the Kennedy Entrance Deferral), location of critical habitat for the endangered Steller sea lion, and in response to comments received during scoping. In part, this deferral was developed as a potential way to reduce conflicts between subsistence users and offshore oil and gas operations based on input from the Native Village of Port Graham, Nanwalek, and Seldovia and others, and analysis of subsistence resource-use patterns. Other comments received during scoping addressed operating conditions in the Kennedy Entrance between the Barren Islands and the lower Kenai Peninsula. The EIS analysis concluded that the deferral would reduce potential impacts to **endangered and threatened species,** including the beluga whale, Steller sea lion, sea otter, humpback whale, and other whales; reduce threats to marine and coastal birds because of their concentration in the deferral area; and reduce **visual resource** effects by moving the potential platform locations farther offshore. The analysis concludes that for most resources, although the alternative would provide a measure of protection to the resources within the deferral area, the effects to the resources in the Cook Inlet area under this alternative would be essentially the same as the effects under Alternative I. As shown by the Lost Opportunity column in Table I.A-1, this deferral reduces by approximately 1% the Opportunity Index; that is, the chance to discover and develop an economic oil field from the sale.

If the Secretary of the Interior decides to proceed with each of the sales (191 and 199), by not choosing Alternative II - No Lease Sale, the Secretary may chose one, all, some combination, or part of the alternatives to comprise the Final Notice of Sale for Sale 191. The Secretary will have all the options available for Sale 199 when that decision is made in 2006. The Secretary may choose the same options selected for Sale 191 or different options.

F. MITIGATING MEASURES

Four standard lease stipulations (1 through 4) are evaluated as part of all the alternatives for both proposed lease sales. These stipulations are

1. Protection of Fisheries
2. Protection of Biological Resources
3. Orientation Program
4. Transportation of Hydrocarbons

Stipulations have been modified, but only slightly, from the versions adopted in previous Cook Inlet lease sales. Combined, these stipulations help lower the potential adverse effects of any proposed lease sale and, in particular, help protect subsistence-harvest activities and sociocultural systems. These measures are perceived as positive actions under Environmental Justice addressing impacts to minority populations.

For both Sales 191 and 199, we evaluate six standard Information to Lessees (ITL) clauses and one optional clause as part of all the alternatives. We have included these or similar standard ITL clauses in previous Cook Inlet lease sales. The ITL clauses provide useful information about other Federal and State rules and regulations that help lower environmental impacts for the proposed sales. The optional ITL clause, No. 7 - Information on Air Quality Regulations and Standards, informs lessees of the regulations in effect for the Cook Inlet area regarding the prevention of significant deterioration for air quality.

G. AGENCY-PREFERRED ALTERNATIVE

As required by the National Environmental Policy Act regulations of the Council on Environmental Quality, the MMS has identified a preferred Alternative for Sale 191 in this final EIS. The agency-preferred alternative is the combination of Alternative III - the Lower Kenai Deferral and Alternative IV - the Barren Islands Deferral, including all stipulations and Information to Lessee clauses described for Alternative I - the Proposed Action. The agency-preferred alternative would defer offering 70 whole or partial blocks with 447 whole or partial blocks (about 2.179 million acres) remaining available for leasing (see Table I.A-1 and Figure I.A-2). The agency-preferred alternative for the subsequent Sale 199 may be modified. Such a modification would be addressed in the Environmental Assessment or supplemental EIS accompanying that sale.

We do not provide a separate evaluation of this alternative, because it would repeat the entire analysis provided in the Alternative III (Section IV.B.3.a) and Alternative IV (Section IV.B.4.a) analyses (please see the EIS for these sections). The overall effects of the agency-preferred alternative essentially are the same as noted for Alternative I with some additional protection to the resources within the deferred area (the effects are additive), especially to **endangered and threatened species**, **marine and coastal birds**, and **archaeological** and **visual resources**.

TABLE OF CONTENTS

Volume I—Executive Summary, Sections I through VI

Volume II—Section VII and Appendixes

APPENDIX F: SCOPING REPORT: OUTER CONTINENTAL SHELF, ALASKA REGION, COOK INLET, OIL AND GAS LEASE SALES 191 AND 199 FOR YEARS 2004 AND 2006 – ENVIRONMENTAL IMPACT STATEMENT

APPENDIX H: AIR QUALITY

APPENDIX I: FEDERAL REGISTER NOTICES

TABLES IN THE APPENDICES

Table Number	Title

Appendix A Tables

Appendix B Tables

FIGURES IN THE APPENDICES

APPENDIX A MAPS

VOLUME III – Tables, Figures, Maps, Bibliography and Index

LIST OF TABLES

Section IV Tables

Section V Tables

LIST OF FIGURES

Figure Number	**Title**

Section I Figures

Section III Figures

MAPS

SECTION I

PURPOSE AND BACKGROUND OF THE PROPOSED ACTION

CONTENTS OF SECTION ONE

I. PURPOSE AND BACKGROUND OF THE PROPOSED ACTION

I.A. PURPOSE, NEED, AND DESCRIPTION

The purpose of the proposed Federal action addressed in this Environmental Impact Statement (EIS) is to offer for lease, in two separate sales, areas on the Cook Inlet Outer Continental Shelf (OCS) that might contain economically recoverable oil and gas resources. This EIS is the National Environmental Policy Act (NEPA) analysis for the first proposed sale enabling the Minerals Management Service (MMS) to conduct the sale-decision process. For efficiency, and consistent with Executive Order 13212 of May 18, 2001, to expedite energy-related projects, this EIS also will be used as the primary NEPA analysis for the second sale. However, a separate sale-decision process will be conducted for the second sale at a later date.

The President's National Energy Policy recommends the continuation of OCS oil and gas leasing on a predictable schedule. Domestic energy production is not expected to increase enough to meet all of the Nation's demand, but an increased domestic energy supply will reduce foreign imports and provide jobs within the United States.

These two lease sales will provide qualified bidders the opportunity to bid on certain blocks in the Cook Inlet to gain conditional rights to explore, develop, and produce oil and natural gas. This EIS addresses these Federal actions, Cook Inlet Sales 191 and 199, scheduled in the *Final Outer Continental Shelf Oil and Gas Leasing Program 2002 -2007* as approved by the Secretary on June 30, 2002. This EIS analyzes the potential environmental impacts in each of the sales, including estimated exploration and development and production activities, on the physical, biological, and human environments.

The OCS Lands Act of 1953 (67 Stat. 462), as amended (43 United States Code [U.S.C.] et seq. [1994]), established Federal jurisdiction over submerged lands on the OCS seaward of the State boundaries. Under the OCS Lands Act, the U.S. Department of the Interior (USDOI) is required to manage the leasing, exploration, development, and production of oil and gas resources on the Federal OCS. The OCS Lands Act sets forth a number of findings and purposes with respect to managing OCS resources. Those principles generally pertain to recognizing national energy needs and related circumstances and addressing them by developing OCS oil and gas resources in a safe and efficient manner that provides for environmental protection, fair and equitable returns to the public, State and local participation in policy and planning decisions, and resolution of conflicts related to other ocean and coastal resources and uses.

The Secretary of the Interior (Secretary) oversees the OCS oil and gas program and is required to balance orderly resource development with protection of the human, biological, and physical environments while simultaneously ensuring that the public receives an equitable return for these resources and that free market competition is maintained. Section 18 of the OCS Lands Act requires receipt of fair market value for OCS oil and gas leases and the rights they convey. The Secretary is empowered to grant leases to the highest qualified responsible bidder(s) on the basis of sealed competitive bids and to formulate such regulations as necessary to carry out the provisions of the OCS Lands Act. The Secretary has designated the MMS as the administrative agency responsible for the mineral leasing of submerged OCS lands and for the supervision of offshore operations after leases are issued.

Three lease sales have been held in the Cook Inlet Planning Area since 1977. The first Federal Cook Inlet lease sale, OCS Sale CI, was held that year, and 87 tracts were leased. The second sale, OCS Sale 60, was held in 1981, and 13 tracts were leased. The third and last sale, OCS Sale 149, was held in 1997, and two tracts were leased. From 1978 through 1985, 13 exploratory wells were drilled in lower Cook Inlet, including one in the Shelikof Strait. All of the wells were plugged and abandoned with no discoveries announced. Recently, Phillips Alaska, Inc. completed the 1 Hansen well in the Cosmopolitan Unit, which includes State leases and the two Federal leases acquired in OCS Sale 149. This well was directionally drilled from an onshore location and was designed to encounter an oil-bearing interval in an adjacent offshore lease. Additional drilling and seismic surveying to evaluate this prospect are being planned. If successful, the resulting production could be the first from Federal leases in Cook Inlet, although most of the unit lies within State waters.

The Secretary has scheduled Sale 191 in 2004 and Sale 199 in 2006. The MMS has prepared a single EIS for the proposed actions for each of the sales. Federal regulations allow for several similar proposals to be analyzed in one EIS (40 Code of Federal Regulations [CFR] 1502.4). The resource estimates and scenario information on which this EIS analysis is presented as a range of activities that could be associated with each of the two sales. This EIS will be used for decisions on Sale 191. The MMS will prepare an Environmental Assessment or supplemental EIS for Sale 199. Formal consultation with the public will be initiated for Sale 199 to obtain input for assisting in determining whether the information and analyses in this EIS are still valid. A sale-specific Information Request will be issued that specifically describes the action for which the MMS is requesting input. The sale process for Sale 191 will require a minimum of 2 years to complete. The sale process for Sale 199 will be somewhat shorter.

On December 31, 2001 (pursuant to 30 CFR 256.23 and 40 CFR 1501.7), the Call for Information and Nominations (Call) and Notice of Intent (NOI) for Oil and Gas Lease Sales 191 and 199 were published in the *Federal Register* (66 *FR* 67543). Nominations and comments on the Call and comments on the NOI closed on February 14, 2002. The Call was published to gather preliminary information and nominations from interested parties on oil and gas leasing, exploration, and development and production within the proposed area. This provided an opportunity for the oil industry, governmental organizations, tribal and local governments, environmental groups, the general public, and all other interested parties to comment on areas of interest or special concern in the proposed lease-sale area. The comments received on the NOI are discussed in Section I.C - Results of the Scoping Process.

Based on available information, the MMS formally identified the location and extent of the area of study for the EIS, four alternatives, and mitigating measures. The area includes 517 whole or partial blocks (about 2.5 million acres, or 1.01 million hectares). As shown in Figure I.A-1, this area is located seaward of the State of Alaska submerged lands boundary and extends from 3 to approximately 30 miles offshore in water depths ranging from approximately 30-650 feet.

Consistent with Section 102(2)(C) of the National Environmental Policy Act, this final EIS describes the proposed lease sales and the natural and human environments, presents an analysis of potential adverse effects on these environments, evaluates potential mitigating measures to reduce the adverse effects of offshore leasing and development, evaluates alternatives to the proposed Federal actions, and presents a record of consultation and coordination with others during EIS preparation. The draft EIS was filed with the Environmental Protection Agency on December 13, 2002, and its availability was announced in the *Federal Register* (67 *FR* 76740). The MMS announced the availability of the draft EIS in the *Federal Register* (67 *FR* 76189) and through other public media. The public had 60 days to review and comment on the draft EIS. Public hearings were held after release of the draft EIS, and specific dates and locations for public hearings were announced in the *Federal Register* (67 *FR* 76189) and other public media. The MMS received oral and written comments at the hearings from the interested members of the public. After receipt and consideration of comments on the draft EIS, the MMS determined the scope of the final EIS.

By regulation and law, the MMS is required to review and analyze the environmental effects of this proposed leasing program. Through the scoping process, we asked for comments and concerns about this proposed program. We have used this information to focus our analysis and to generate reasonable alternatives for analysis. Through the remainder of the process we continued to solicit information and suggestions.

We have responded to comments on the draft EIS, both written and oral, in Section VII. Comments were received in letters, public hearings, government-to-government meetings, and from e-mails sent to the MMS e-mail address.

The agency-preferred alternative is the combination of Alternative III - the Lower Kenai Deferral and Alternative IV - the Barren Islands Deferral, including all stipulations and Information to Lessees clauses described for Alternative I - the Proposed Action. Although we have identified our agency-preferred alternative as required by NEPA Council of Environmental Quality regulations, if the Secretary of the Interior decides to proceed with each of the sales (191 and 199), by not choosing the Alternative II - No Lease Sale, the Secretary may chose one, all, or some combination or part of the alternatives to comprise the Final Notice of Sale for Sale 191. We will continue to maintain an open mind throughout and the final decision and will continue to consider and evaluate comments and all reasonable options.

I.B. LIST OF LEGAL MANDATES

The following list references legal mandates that affect Federal activities proposed on the OCS. These statutes are Federal public laws enacted by Congress and are associated with proposed leasing, exploration, development and production, or other activities that might significantly affect the OCS. This is not intended to be a comprehensive list of all the laws but rather to acquaint the reader with the law. Readers should always consult the entire text of the laws for updated information and additional requirements.

Appendix E of this EIS contains further information, explanations, or summaries of the following legal mandates and other legal requirements (such as executive orders, regulations, and agreements) that directly or indirectly relate to the Department of the Interior, the MMS, and other Federal Agencies' regulatory responsibilities for mineral leasing, exploration, and development and production activities on leases located in the submerged lands of the OCS located offshore Alaska.

- Submerged Lands Act of 1953 (43 U.S.C. § 1331 et seq.)
- Outer Continental Shelf Lands Act of 1953, as amended (43 U.S.C. § 1331 et seq.)
- National Environmental Policy Act of 1969, as amended (42 U.S.C. § 4321 et seq.), and the Council on Environmental Quality regulations (40 CFR parts 1500 through 1508)
- Clean Air Act of 1970 and the Clean Air Act Amendments of 1990 (42 U.S.C. § 740 et seq.)
- Federal Water Pollution Control Act of 1972, as amended (33 U.S.C. § 1251 et seq.), and the Clean Water Act of 1977 (91 Stat. 1566)
- Coastal Zone Management Act of 1972, as amended (16 U.S.C. § 1451 et seq.), the Coastal Zone Reauthorization Amendments of 1990 (Public Law (P.L.) No. 101-508), and the Coastal Zone Protection Act of 1996 (P.L. No. 104-150)
- Energy Policy and Conservation Act of 1975 (42 U.S.C. § 6213 et seq.)
- Export Administration Act of 1969 (50 App. U.S.C. 2405(d))
- Marine Mammal Protection Act of 1972, as amended (16 U.S.C. § 1361 et seq.)
- Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. § 703-712)
- International Convention of the Prevention of Pollution from Ships and Marine Plastics
- Pollution Research and Control Act of 1988 (33 U.S.C. § 1901 et seq.)
- Marine Protection, Research, and Sanctuaries Act of 1972, as amended (33 U.S.C. § 1401-1445 and 16 U.S.C.§ 1431-1445)
- National Fishing Enhancement Act of 1984 (33 U.S.C. § 2101 et seq.)
- Magnuson-Stevens Fishery Conservation and Management Act of 1976 (16 U.S.C. § 1801 et seq.)
- Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 et seq.)
- National Historic Preservation Act of 1966, as amended (16 U.S.C. § 470 et seq.)
- Oil Pollution Act of 1990, as amended (33 U.S.C. § 2701 et seq.)
- Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. § 401 et seq.)
- Resource Conservation and Recovery Act of 1976 (42 U.S.C. § 6901 et seq.)
- Ports and Waterways Safety Act of 1972, as amended (33 U.S.C. § 1221 et seq.)
- Merchant Marine Act of 1920 (commonly referred to as the Jones Act) (P.L. No. 66-261)
- Federal Oil and Gas Royalty Management Act of 1982 (30 U.S.C. § 1701 et seq.)
- Arctic Research and Policy Act of 1984 (15 U.S.C. § 4101 et seq.)
- The Bald Eagle Protection Act (16 U.S.C. § 668-668d)
- The Fish and Wildlife Coordination Act (16 U.S.C. § 661-667e)

- Executive Order 13212 - Actions to Expedite Energy-Related Projects
- Executive Order 13175 - Consultation and Coordination with Indian Tribal Governments
- Executive Order 13158 - Marine Protected Areas
- Executive Order 12114 - Environmental Effects Abroad
- Executive Order 13112 - Invasive Species
- Executive Order 13007 - Indian Sacred Sites
- Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
- Executive Order 11990 – Protection of Wetlands
- Executive Order 11988 – Floodplain Management

The OCS Lands Act and the Oil Pollution Act of 1990 have been codified into regulation at 30 CFR 250 and 254 respectively. Inspectors from the MMS routinely visit all OCS-permitted facilities to ensure that lessees or/or their designated operators are complying with the MMS rules, regulations, and lease-sale stipulations (see Section II.F). If possible, the MMS inspectors provide continuous presence during exploration and development drilling operations. During routine production operations and demobilization, the MMS inspectors routinely inspect and monitor operations through announced and unannounced inspections. If violations or infractions occur, the MMS inspectors will take appropriate actions, which can range from warnings to rig shut down to lease withdrawals and monetary penalties, depending on the severity and type of infraction. If the MMS inspectors observe violations or infractions with other applicable Federal Laws and Rules, they will notify the regulation agency(ies), so they can take appropriate action.

I.C. RESULTS OF THE SCOPING PROCESS

Scoping is defined as "an early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). The NOI published for Oil and Gas Lease Sales 191 and 199 (66 *FR* 67543) described the scoping process MMS followed for this EIS. Throughout the scoping process, comments are invited from any interested persons, including affected Federal, State, tribal and local governments; any affected Native groups; conservation groups; and private industry for early identification of the most important issues for analysis in this EIS. Scoping provides those with an interest in the OCS program an early opportunity to participate in the events leading up to the final publication of an EIS and aids the MMS in determining the significant issues and alternatives to be analyzed in an EIS. The intent of scoping is to avoid overlooking important issues that should be analyzed in an EIS. The entire text of the Scoping Report is in Appendix F of this EIS.

In response to the Call/NOI, approximately 20 organizations, including Alaskan Natives, environmental organizations, private industry, and local, State, tribal, and Federal government agencies provided comments. The MMS held public scoping meetings in nine communities; conducted government-to-government contacts with Native Alaskan tribes and local governments; and met with organizations representing commercial- and sport-fishing interests, industrial energy consumers, and two Cook Inlet citizens' environmental monitoring groups. Three companies and one oil and gas trade association representing the majority of oil and gas exploration, production, transportation, refining, and marketing activities in Alaska commented. Nominations indicate varied interest in portions of the program area and, when considered in total, they cover the entire sale area.

Scoping for this multiple-sale EIS included reviewing the comments received on the Call and NOI; comments submitted at the scoping meetings; the issues raised and analyzed in the EIS's for previous Cook Inlet Planning Area lease sales (Sales CI, 60, and 149); and MMS staff evaluation and input. Scoping comments were used to identify major issues, alternatives to the Proposed Action, and measures that could mitigate the effects of the proposed Federal actions. Scoping comments were requested from the public through newspaper, radio, and television advertisements in Anchorage, Kenai, Homer, and Kodiak. Scoping meetings were held in 2001 in Homer (January 30), Seldovia (January 31), Ninilchik (January 28), Kenai (January 29), Kodiak (January 30), and Anchorage (February 5). Government-to-government scoping meetings were held with the Native Village of Nanwalek (February 8), the Native Village of Port Graham (February 11), and the Seldovia Village Tribe (February 1).

We incorporated the various inputs from scoping. For example, we made sure that the draft EIS analysis specifically considered potential effects to the environmentally sensitive areas identified during scoping. We used several techniques to ensure this information was considered in the analysis including:

- Designation of environmental resource areas used in the analysis of potential effects from OCS activities.
- Identification of land segments that comprise the sensitive habitat areas.
- Recognition of sensitive areas identified in the development of the Cook Inlet geographic response strategy, a collaborative process among area stakeholders that identifies and ranks the most valuable resources and habitat and develops site specific oil-spill-response strategies for the sites. These geographic response strategies are part of the Alaska Regional Response Team's Cook Inlet Subarea Contingency Plan.
- Identification of areas for particular consideration in oil-spill-response plans, such as those listed in Information to Lessee No. 3.

After the first phase of scoping was complete, the scoping process continued through the publication of the final EIS, and additional outreach meetings were held, as needed or as requested by local communities. The scoping process will continue throughout of the life of the multiple-sale EIS process. As each sale analyzed within this document is considered for leasing, the scoping process will be initiated.

I.C.1. Major Issues Considered in This EIS

I.C.1.a. Issues Detailed in This EIS

The major issues analyzed in this EIS are the direct result of concerns raised during the scoping process. Based on these issues, the MMS selected the following resource topics for effects analyses in Section IV.B: water quality; air quality; lower trophic-level organisms; fisheries resources; essential fish habitat; endangered and threatened species; marine and coastal birds; nonendangered marine mammals; terrestrial mammals; economy; commercial fishing; subsistence-harvest patterns; sociocultural systems; recreation, tourism, and visual resources; sport fisheries; environmental justice; archaeological resources; national and State parks and special areas; and coastal zone management.

While many environmental issues were raised in scoping, all significant ones identified were addressed to some degree in the previous Sale 149 final EIS (USDOI, MMS, Alaska OCS Region, 1995). The following environmental issues are identified and analyzed in this EIS as important resources, activities, systems, or programs that could be affected by OCS exploration, development and production, and transportation activities associated with the proposed Sales 191 and 199. The cumulative effects of past, present, and future activities on each of these resources, activities, systems, or programs also are analyzed in this EIS.

I.C.1.a(1) Water Quality from Discharge of Drilling Fluids and Cuttings

Commenters highlighted the concerns over contamination of sediments, the water column, and the food chain that may be associated with offshore oil and gas development and other sources, such as nonpoint-source pollution. These substances may be concentrated further in certain areas by eddies that form in the Cook Inlet. The commenters' input accentuates the concern over accumulation of toxins in organisms and the potential health effect that it may have on subsistence consumers of the resource. The comments identified a number of reports that may provide information for evaluating this issue. Some commenters expressed a preference for zero discharge of muds and cuttings during exploration, development, and production. They also asked for an explanation of why this may not be achievable in some circumstances other than that the discharge is allowed under a regional exemption to the Clean Water Act for platform discharge.

I.C.1.a(2) Subsistence-Harvest Patterns

Closely related to the water quality issue, commenters requested that a broad definition be given to subsistence, noting the importance of all ocean resources in the area for Alaskan Natives. A particular concern is the potential contamination of some of these resources from postlease activities, other non-OCS activities, and oil spills. Commenters emphasized the impacts of the *Exxon Valdez* oil spill on subsistence. Commenters requested that specific plans be developed to avoid impacts from exploration and development on subsistence resources and asked that the eastern portion of lower Kenai Peninsula be considered as a deferral alternative.

I.C.1.a(3) Oil Spills

The ability of operators and the government to respond to prevent or control oil spills was questioned. Commenters expressed attendant concerns regarding the adequacy of existing contingency plans, response coordination among agencies, distribution and adequacy of response capabilities, response in adverse weather conditions, training and deployment of local respondents, the cost of cleanup, and the identification of critical habitat. Particular reference was made to the past and continuing impact of the *Exxon Valdez* oil spill on the area.

I.C.1.a(4) Wildlife and Aquatic Habitat

Commenters asserted that fish and wildlife and their habitats, including migration routes, could be impacted by offshore oil and gas activities. People remarked on the need to identify sensitive fish habitat and endangered species habitat, monitor these habitats, and acquire geographic information system-based maps of the biologically sensitive areas as an aid in decisionmaking. Commenters identified several biologically sensitive locations, including Anchor Point. Commenters noted the importance of the Barren Islands to marine mammals and migrating birds and requested that the area be considered for deferral. Commenters identified several species that may be affected in varying degrees by offshore oil and gas including bears; beluga whales; kelp; Pacific herring; Steller sea lions; salmon; sea otters; Steller's eiders; Tanner and other crab species; and shore, marine, and coastal birds. Commenters requested that Kachemak Bay be considered as a deferral alternative.

Some commenters suggested that the EIS analysis separately consider impacts from leasing to special areas—areas that are legally defined and regulated with the objective of protecting resources for their inherent biological or ecological values. These areas include units within the national park system, national wildlife refuges, national estuaries, designated wilderness areas, and State critical areas. Units specifically identified by commenters include the Aniakchak National Monument and Preserve, Duck and Chinik islands, Katmai National Park and Preserve, Lake Clark National Park and Preserve, Alaska Maritime National Wildlife Refuge, and the McNeil River Bear Sanctuary. People asked that the siting of onshore facilities and impact on land use and private property rights also be examined. Some commenters asked that the EIS examine impacts to Areas Meriting Special Attention (AMSA).

I.C.1.a(5) Socioeconomics

Commenters indicated that the direct and indirect positive and the negative effects from the lease sales on the cultural, social, and economic well-being of people should be considered. These impacts include the effects from the lease sale, including oil spills, to the tourism, recreational, and quality-of-life uses of the area; labor migration and population inmigration to communities; on the demand for public services; and on public finances and revenues. Respondents suggested that we consider the potential diversification of the local economy, changes to the character of the communities, and the potential for local use of resources that may result from the lease sale. Comments recommended evaluation of the indirect effects of revenues, royalties, and corporate profits from the lease sale.

I.C.1.a(6) Commercial and Recreational Fishing

Commenters emphasized the importance of the commercial and recreational fishery of lower Cook Inlet to the economic well-being and quality-of-life aspects of the area. They also expressed concerns over the effects leasing may have on these resources, including conflicts that may result between offshore energy activity and fishing activity. Commenters suggested that specific plans be developed to minimize and avoid conflicts between commercial-fishing gear and exploration and development activities. Examples of areas identified where conflicts may result include riptide areas favored by driftnet fishing, areas of setnet fishing, and the potential restoration of the Tanner crab fishery around Cape Douglas.

I.C.1.a(7) Tri-Borough Agreement

While not a separate issue, several commenters noted that the MMS needs to specifically consider the five issues in the January 24, 2002, Tri-Borough Agreement prepared and approved by the Kenai Peninsula Borough, Kodiak Island Borough, and the Lake and Peninsula Borough. The five issues include no offshore loading of tankers; specific plans to minimize and avoid commercial fishing gear conflicts with exploration and development activities; adequate spill-prevention and -response capability by the exploration company; identification of critical habitat areas; and local government revenue sharing.

I.C.1.b. Issues Raised During Scoping that Were Considered but Did Not Warrant Further Detailed Analysis in this EIS

The following issues were raised during the scoping process for this sale and previous Cook Inlet lease sales. These concerns were fully evaluated by the MMS staff but are not being analyzed further for the reasons indicated. Several comments were received that were not relevant to the Proposed Action, and alternatives analyzed in the EIS are described in the Scoping Report in Appendix F.

I.C.1.b(1) Revenue Sharing and Impact Assistance

One issue repeatedly identified as being of primary concern to the Tri-Boroughs is the need for revenue sharing assistance to local communities from OCS receipts. Impact assistance would require congressional action and cannot be addressed or resolved through the EIS process. The MMS has worked diligently at finding a solution to this issue for more than 20 years. During the 1997-2002 Five-Year Oil and Gas Leasing Program, the OCS Policy Committee provided recommendations for such revenues to appropriate congressional staff. However, Congress, not the MMS, makes the decision. Congress passed a version of revenue sharing legislation for Fiscal Year 2001. The Coastal Assistance Program has its roots in the Conservation and Reinvestment Act, which did not pass into legislation. As a compromise measure, the OCS Lands Act was amended to include the Coastal Assistance Program. The program authorized a one-time appropriation of $150 million divided among the seven states with offshore oil activities—Alabama, Alaska, California, Florida, Louisiana, Mississippi, and Texas. Among the producing States, 60% of the funds were divided equally, and 40% were based on OCS production. Based on formula, Alaska received a one-time appropriation of $12,208,723, of which $7,935,670 was allocated to the State, and $4,273,053 was divided among the coastal political subdivisions. Funds were distributed to eligible communities based on population, coastline miles, and relative distance from any OCS leased tracts. The allocation for the Cook Inlet area governments was $1.204 million. The National Oceanic and Atmospheric Administration administers the Coastal Assistance Program.

I.C.1.b(2) Process Issues

Several comments were received about issues that relate to the terms, conditions, or conduct of the sale but were not environmental in nature. Suggestions included comparing royalties received by the State with profit received by the corporations from operations in lower Cook Inlet, and limiting the scope of the sales to those tracts that might hold industry interest. Other comments included exploring whether variable terms and options in lease sales will attract new interest. The MMS is considering offering suspension of royalties on initial volumes of oil from new production. Given that development occurs from newly offered tracts, these suspensions would not be expected to change the resource estimates that provide the basis for the hypothetical scenario used to analyze environmental effects of the Proposed Action. If production would occur on leases with such suspensions, payments to government, including those from the production allocated to leases in the 8(g) zone, would be suspended until such initial volumes were achieved.

I.C.1.b(3) Global Climate Change

Global climate change and the contribution OCS activities makes to greenhouse-gas emissions are more appropriately addressed as a programmatic concern in Section 4.1.2 of the final EIS for the 2002-2007 oil and gas leasing program (USDOI, MMS, 2002). This is in accordance with the recommendation of the Council of Environmental Quality, Draft Guidance Regarding Consideration of Global Climate Change in Environmental documents Prepared Pursuant to the National Environmental Policy Act, October 8, 1997, that this issue be addressed at the program level rather than at the project level. The final EIS estimated total emissions of carbon dioxide and methane for activities associated with the 5-year program. In the Alaska OCS Region, estimates indicate that production activities could emit about 75% of the carbon dioxide emissions, while tankers carrying Alaska North Slope crude between Valdez and the west coast contribute about 10% to the total. Tankers produce most of the methane emissions, with the remainder coming primarily from production facilities. The combined carbon dioxide and methane emissions from the entire proposed OCS 5-year program, including the Alaska region, are about 0.04-0.08% of the Nationwide total. The estimated combined carbon dioxide and methane emissions from the entire OCS program activities would be about 0.01-0.02% of the global emissions.

I.C.1.b(4) Traditional Knowledge

Traditional knowledge or indigenous knowledge uses the information, advice, and wisdom that have evolved over centuries of living as part of the environment. It is a valuable source of environmental information that allows communities to realize their own expertise and apply their own knowledge and practices to help protect their way of life. For the Southcentral Alaska region, a great deal of traditional knowledge has been collected from Native Alaskans through past and more recent testimony from community meetings on lease-sale hearings, research sponsored by the MMS Environmental Studies Program, and subsistence-harvest surveys and ethnography conducted by other Federal and State agencies. This information is disseminated in research reports, searchable on-line databases, and published scientific literature. For example, the MMS-sponsored research (Fall et al., 2001) collected information from Native Alaskan respondents on changes in Native cultural practices. This information is incorporated into the analysis of potential effects from the Proposed Action in Section IV.B.1.p. Similarly, Section III.C.3.d describes regional traditional knowledge on subsistence, making extensive use of information contained in the Alaska Department of Fish and Game Whiskers! Database. Finally, Section III.B.4.b(1) describes the natural history of the beluga whale, making extensive use of information provided by Native Alaskans in published scientific research. Using these information sources incorporates traditional knowledge into the EIS text and provides it to MMS decisionmakers without burdening Native Alaskans by requesting they provide information that has already been collected and disseminated. In-depth information regarding traditional knowledge used in this EIS is contained in Section IV.B.1.p - Environmental Justice.

I.C.1.b(5) Tankering of Non-OCS Crude Oil

Several comments questioned regulation of non-OCS tankering in Cook Inlet. While tankering is addressed in the description of the affected environment, the no action alternative, and cumulative effects analysis, the tankering of OCS crude is not foreseen as part of the Proposed Action (Alternative I).

I.C.2. Development of Alternatives

Alternatives to the Proposed Action were considered twice during the development of the EIS for Cook Inlet. The first instance occurred during scoping that immediately followed the publication of the NOI. Using information provided by the interested and affected public, we crafted alternatives to satisfy the NEPA requirement that the analysis in the EIS consider a range of alternatives. The second instance occurred as a result of public comments received on the draft EIS, which we evaluated to identify possible new or modified alternatives and to determine if they meet the NEPA guidance for inclusion as an alternative in the final EIS. Unlike the deferral alternatives that resulted from scoping, we had the advantage of using the information in the draft EIS in evaluating the potential new or modified alternatives suggested in comments received on the draft EIS.

Following the release of the NOI, the MMS initiated scoping. Section I.D of the EIS summarizes the scoping process and issues raised by the public and others. Appendix F of the EIS contains the Scoping Report. Comments received during scoping identified several sensitive habitat areas and asked that these receive particular attention in the analysis of potential effects from OCS activities. These areas included the Barren Islands, Anchor Point, State and national parks and refuges, and Areas Meriting Special Attention. Comments also requested that certain areas be considered for deferral, such as Kachemak Bay, or that certain areas be included in the lease sales. Comments from the Native Village of Port Graham included a map that identified two areas to be considered for deferral. As part of the scoping process, we examined the areas considered for leasing and deferral in past Cook Inlet lease sales.

After considering public input, reviewing past lease-sale areas and effects, and evaluating the distribution of environmental resources throughout the entire Cook Inlet area, we developed two alternatives to the Proposed Action for analysis in the draft EIS. Section I.C.2.a describes the Proposed Action, no action, and two deferral alternatives.

The comments on the draft EIS, contained in Section VII of the EIS, requested that we examine several possible new or modified alternatives to the Proposed Action. Careful examination of the comments indicated that the alternatives fell into four groups:

1. No-Rig Zones (No Surface Occupancy) in Environmentally-Sensitive Areas
2. Tuxedni National Wilderness Area Deferral
3. Expand the Lower Kenai Peninsula Deferral
4. Expand the Barren Islands Deferral

No-rig zones and the Tuxedni National Wilderness Area deferrals were proposed by the commenters as possible new alternatives, while the other two were modifications to existing alternatives. Section I.C.2.b explains why these were not included for further analysis.

I.C.2.a. Alternatives to be Further Evaluated

The following four Alternatives are considered in this EIS for Sales 191 and 199:

- Alternative I – Proposed Action
- Alternative II – No Lease Sale
- Alternative III – Lower Kenai Peninsula Deferral
- Alternative IV – Barren Islands Deferral

These alternatives were developed during the scoping process in response to comments and concerns and further refined by the MMS. In scoping, the MMS did not receive any suggestions to consider the alternatives evaluated for Sale 149, our most recent Cook Inlet sale. Most alternatives evaluated for Sale 149 were suggested as a way to help avoid potential conflicts with commercial-fishing activities. However, the analysis for Sale 149 found they were not that effective in eliminating the potential use conflicts.

I.C.2.a(1) Alternative I – Proposed Action

Alternative I - the Proposed Action for each sale would offer for lease those blocks selected as a result of the Area Identification. As shown in Figure I.A-1 and Table 1.A-1, the Cook Inlet multiple-sale area includes 517 whole or partial blocks covering 2.5 million acres (about 1.01 million hectares) in Cook Inlet. This alternative reflects an estimated resource development and activity of 140 million barrels of recoverable oil and 190 billion cubic feet of natural gas. For purposes of analysis, we assume that the oil and gas will be recovered as a result of a single development, which might result from either or both sales. The multiple-sale area was identified as being of high and medium interest to industry and is the entire area of the Call. In March 2002, the MMS Director designated the program area to be the area that would be considered for leasing through the Proposed Action. The Area Identification process for Sale 199 will take place later. However, the areal extent selected for Sale 199 cannot be larger than the area evaluated in Alternative I of this EIS, because the proposed sale area (Alternative I) is the same as the entire Cook Inlet program area in the 2002-2007 5-year program.

I.C.2.a(2) Alternative II – No Lease Sale

Under Alternative II, we could choose not to hold one or both of the proposed sales. For each lease sale, this alternative would remove the entire area of Alternative I - Proposed Action from leasing.

I.C.2.a(3) Alternative III – Lower Kenai Peninsula Deferral

Alternative III - Lower Kenai Peninsula Deferral, was developed by the MMS based on analysis of areas offered for leasing in Sale 149 (for example, the Kennedy Entrance Deferral), location of critical habitat for the endangered Steller sea lion, and in response to comments received during scoping. In part, this deferral was developed as a potential way to reduce conflicts between subsistence users and offshore oil and gas operations and was based on input from the Native Village of Port Graham and others and analysis of subsistence-resource-use patterns. Other comments received during scoping addressed the compatibility of offshore oil and gas activity with recreation, tourism, and visual resources in the Kachemak Bay and lower Cook Inlet area. Alternative III would offer for leasing all of the area described for Alternative I except for a subarea located in the eastern portion of the proposed sale area offshore of Homer, Seldovia, Port Graham, and Nanwalek. As shown in Figure I.A-1 and Table I.A-1, Alternative III would offer 483 whole or partial blocks, comprising 2,337,000 acres (about 945,770 hectares). The areas that would be removed by the Lower Kenai Peninsula Deferral consist of 34 whole or partial blocks, approximately 163,100 acres, which is about 6.5% of the Alternative I area. This option is being analyzed to estimate potential protection of subsistence-use zones and wildlife areas and other resources in the area from potential exploration or development and production activities.

I.C.2.a(4). Alternative IV – Barren Islands Deferral

Alternative IV - Barren Islands Deferral was developed by the MMS based on analysis of areas offered for leasing in Sale 149 (for example, the Kennedy Entrance Deferral), location of critical habitat for the endangered Steller sea lion, and in response to comments received during scoping. In part, this deferral was developed as a potential way to reduce conflicts between subsistence users and offshore oil and gas operations and was based on input from the Native Village of Port Graham and others and analysis of subsistence-resource-use patterns. Other comments received during scoping addressed operating conditions in the Kennedy Entrance between the Barren Islands and the lower Kenai Peninsula. Alternative IV would offer for leasing all of the area described for Alternative I except for a subarea located off of the Barren Islands. As shown in Figure I.A-1 and Table I.A-1, Alternative IV would offer 481 whole or partial blocks, comprising 2,342,000 acres (about 947,794 hectares). The areas that would be removed by the Barren Islands Deferral consist of 36 whole or partial blocks, approximately 158,000 acres, which is about 6.32% of the Alternative I area. This option is being analyzed to estimate potential protection of subsistence-use zones and wildlife areas and other resources in the area from potential exploration or development and production activities. Requests for such possible protection were made in Homer, Seldovia, Port Graham, and Nanwalek.

I.C.2.a(5) Agency-Preferred Alternative

As required by NEPA regulations of the Council on Environmental Quality, the MMS has identified its agency-preferred alternative for Sale 191 in this final EIS. The agency-preferred alternative is the combination of Alternative III - the Lower Kenai Deferral and Alternative IV - the Barren Islands Deferral, including all stipulations and ITL clauses described for Alternative I - the Proposed Action. The agency-preferred alternative for the subsequent Sale 199 may be or may not be modified prior to holding the sale. Such a modification would be addressed in the Environmental Assessment or supplemental EIS prepared for that sale.

As shown on Figure IA-2 and Table IA-1, the agency-preferred alternative would offer 447 whole or partial blocks, comprising 2,179,000 acres (about 882,127 hectares). The area that would be deferred from Sale 191 under this alternative consists of 70 whole or partial blocks, approximately 321,900 acres (129,609 hectares), which is about 12.8% of the Alternative I area.

We do not provide a separate evaluation of this alternative, because it would repeat the entire analysis provided for Alternative III (Section IV.B.3) and Alternative IV (Section IV.B.4). The analysis includes evaluation of the effectiveness of all standard stipulations (mitigating measures) that are included in this agency-preferred alternative. We have added the agency-preferred alternative information to Table I.A-1 and Figure IA-2 and prepared Table II.B-3, which summarizes the effects of the agency-preferred alternative. Table II.B-3 indicates that for most resources, the effects of the agency-preferred alternative are essentially the same as the effects of Alternative I. However, because the agency-preferred alternative defers a portion of the area from Sale 191, it reduces effects to endangered and threatened species, marine and coastal birds, archaeological resources, and recreation and visual resources while reducing effects to the other resources that are proximate to the lower Kenai Peninsula and the Barren Islands, compared to Alternative I. Although we have identified MMS's agency-preferred alternative, we will continue to maintain an open mind throughout the decision process and will continue to consider and evaluate comments and all reasonable options.

I.C.2.b. Alternatives Considered but Not Included for Further Analysis

This section discusses the possible alternatives recommended by commenters that we considered and provides the rationale for our conclusion that they not be included for further analysis in the EIS.

I.C.2.b(1) No-rig Zones (No Surface Occupancy) in Environmentally Sensitive Areas

Comments on the draft EIS requested that we consider a possible new alternative by designating all environmentally sensitive areas within Cook Inlet as so-called "no-rig zones." We did not include this alternative for further analysis. The analysis of this possible new alternative indicates that many of the areas are not within the OCS area considered for the lease sales, some areas identified in the comments already are analyzed as part of other alternatives to the Proposed Action, or the "no-rig zone" alternative offers no greater measure of protection to resources than the Proposed Action.

I.C.2.b(1)(a) Definition of the Concept

Comments did not precisely define the meaning of the term "no-rig zone." Narrowly defined, the term refers to the prohibition against placement of exploration rigs or production platform on OCS leases that comprise the environmentally sensitive area, while allowing other infrastructure such as subsea completions and gathering pipelines. Broadly defined, the term "no surface occupancy" refers to the prohibition against the placement of OCS exploration, development, and production infrastructure but would not prevent placement of pipelines to onshore processing plants. Under this definition, development could only occur from extended-reach drilling originating from outside the environmentally sensitive area. We use the broad definition of the term in our evaluation. (In the Sale 149 final EIS, we evaluated Stipulation No. 7 - No Surface Entry During Development and Production as a means of reducing or eliminating space-use conflicts with commercial-fishing gear. However, Stipulation No. 1 - Protection of Fisheries, which requires development of specific plans to reduce conflict, was selected because it offers a much more flexible approach to reducing conflict. It does not preclude a "no surface entry" but does not mandate its use exclusively.)

I.C.2.b(1)(b) Definition of Environmentally-Sensitive Areas and Resources

Comments on the draft EIS specifically identified the following places as environmentally sensitive areas: Kennedy Entrance, Stevenson Entrance, Kachemak Bay, Tuxedni Bay, Kamishak Bay, Katmai National Park and National Preserve, Lake Clark National Park and National Preserve, Shuyak State Park, and the OCS area between Katmai National Park and Preserve and the Barren Islands. One comment explicitly mentioned the commercial scallop beds near Augustine Island. Other comments were more general, asking possible alternatives to defer environmentally sensitive areas that could be impacted by an oil spill. However, most comments did not indicate specific boundaries or resources for any area. To completely evaluate the comments, we had to geographically define each area and identify the specific environmentally sensitive resources within each area, before considering the effects to those resources from routine operations and an unlikely large oil spill.

As part of the scoping process, we identified 19 physical, biological, and social-systems resources that could be affected by the Proposed Action and other alternatives and that were evaluated in the draft EIS. Section III of the draft EIS describes the baseline conditions of these resources. Section IV discussed potential effects of the Proposed Action and alternatives on these resources. Section V discusses the cumulative effects of the Proposed Action combined with past, present, and reasonably foreseeable activities on the resources. Many of these resources are distributed throughout the Cook Inlet. Some resources may be more prevalent in some portions of the Inlet compared to other areas. As such, the analysis addresses aspects of areawide and site-specific distribution for each of the resources.

To evaluate the requests for a possible "no-rig zone" alternative, we examined the extent to which the draft EIS discusses the potential effects from the Proposed Action on the resources in general and the effects on certain resources in the specific environmentally sensitive areas identified in the comments. Because the comments did not precisely define the boundaries of any area or specify the environmentally sensitive resources therein, we did so using environmental resource areas (ERA's) and land segments. As shown on Map A-2 and Table A.1-7b, we had designated several environmental resource areas to define geographic concentrations of certain sensitive biological and social systems resources (terrestrial mammals, nonendangered marine mammals, endangered and threatened species, marine and coastal birds, and subsistence-harvest resources). Furthermore, as shown on Map A-3, we divide the area into land segments (LS's) for oil-spill-trajectory analysis. Using this information, we identified the environmental resource areas and land segments that approximately correspond to the environmentally sensitive areas mentioned in the comments.

Definition of these areas revealed that most or all of the areas of Tuxedni Bay and Lake Clark National Park and National Preserve, Kamishak Bay, Katmai National Park and National Preserve, Shuyak State Park and the associated environmental resource areas are outside the OCS area offered for lease under Sale 191 and 199.

The Kennedy Entrance, Stevenson Entrance, and Barren Islands areas are incorporated into Alternative IV - the Barren Islands Alternative, which considers deferral of the entire area from leasing, not just a restriction on surface occupancy. Therefore, analyzing this area as a possible "no-rig zone" essentially would replicate the analysis done in Section IV.B.4 since the deferral subsumes no surface occupancy.

Kachemak Bay lies entirely within State waters. The State prohibits surface entry in the Bay, which essentially creates a "no-rig zone." Alternative III - the Lower Kenai Peninsula Deferral incorporates most of the OCS tracts encompassing the environmental resource areas associated with Kachemak Bay. Therefore, analyzing this area as a possible "no-rig zone" essentially would replicate the analysis in Section IV.B.3, becuase the deferral subsumes no surface occupancy.

The OCS area between Katmai National Park and Preserve and the Barren Islands does not have an associated environmental resource area or land segments. Therefore, we consider the resources in this area to be part of the widely distributed resources analyzed as part of Alternative I - the Proposed Action. Therefore, analyzing this area as a possible "no-rig zone" essentially would replicate the analysis in Section IV.B.1.

I.C.2.b(1)(c) Evaluation of the "No-Rig Zone" Alternative

Routine operations include exploration and production platform emplacement, drilling, production, and support activities, and small oil spills. The draft EIS analysis of potential effects of the Proposed Action (Alternative I) from routine operations found less than significant effects to terrestrial mammals (Section IV.B.1.i), nonendangered marine mammals (Section IV.B.1.h), marine and coastal birds (Section IV.B.1.g), endangered and threatened species (Section IV.B.1.f) and subsistence-harvest patterns (Section IV.B.1.l). A "no-rig zone" alternative essentially would replicate the analysis conducted in these sections. As such, deferring an area as a "no-rig zone" would not change the less than significant effects from routine operations.

The EIS explicitly analyzes potential effects of an unlikely large oil spill contacting the environmental resource areas, the resources therein, and the land segments that correspond to each of the environmentally sensitive areas identified in the comments. For each area, our analysis revealed that deferring an area as a "no-rig zone" does not eliminate the chance that an unlikely large oil spill could contact the environmental resource area or land segments. Spills that originate outside the area that would be designated as a "no-rig zone" still contact the environmental resource area and land segments within the "no-rig zone." Furthermore, spills that originate from non-OCS sources, such as marine transportation, could contact the environmental resource area and land segments within the "no-rig zone." As such, deferring an area as a "no-rig zone" would not effectively change the overall effects from an unlikely large oil spill.

Although, for purposes of analysis in this EIS, we assume that an unlikely large oil spill occurs, the most likely number of large spills occurring from the two sales is zero. The expected absence of a large spill in part is a reflection of the emphasis that the regulations governing offshore operations place on preventing accidental releases. Moreover, our estimate of the effects of an oil spill in the draft EIS does not consider any reduction in effects that would result from oil-spill-response activities. However, the analysis of potential effects for each of the resources concluded that the stipulations and ITL's assumed to be part of the Proposed Action and all alternatives would reduce effects from routine operations and oil spills. Information to Lessee No. 3 - Sensitive Areas to be Considered in Oil-Spill-Response Plans - specifically lists each of the environmentally sensitive areas identified in the comments and informs the lessee that oil-spill-response plans must specifically consider these areas. The prevention provided by the regulations and the mitigation provided by stipulations and ITL's provide a level of protection to the resources and land segments that is equal to, if not superior to, that offered by designation of the area as a "no-rig zone."

A possible alternative that collectively would defer all these environmentally sensitive areas that could be affected by an unlikely large oil spill is the equivalent of Alternative II – No Lease Sale. Environmental Resource Areas 1 through 8 correspond to the environmentally sensitive areas identified in the comments. As shown in Table A.2-2, the collective area could be contacted from a spill originating from LA's 1 through 7—every launch area shown on Map A-4. To protect ERA's 1 through 8 from an unlikely large oil spill, we would have to defer all launch areas—the entire sale area—which is the equivalent of Alternative II – No Lease Sale.

I.C.2.b(2) Tuxedni National Wilderness Area Deferral

In comments on the draft EIS, the Fish and Wildlife Service requested that we consider a possible new alternative to provide the area proximate to Chisik Island in Tuxedni Bay an adequate buffer of no industrial activity to maintain standards of the Clean Air Act. We concluded that this possible new alternative should not be included for further study because it provides no greater level of protection to the air quality of the Tuxendi National Wilderness Area than that provided by existing regulations.

Section IV.B.1.b of the draft EIS discusses the Class I status of Prevention of Significant Deterioration for this area, designated as a national wilderness area within the Alaska Maritime National Wildlife Reserve. The MMS air quality modeling shows that the highest pollution concentrations from the Proposed Action would be well within the Class I Prevention of Significant Deterioration limits. However, the Environmental Protection Agency has jurisdiction for air quality over the Cook Inlet program area, and lessees must comply with their requirements for OCS sources. Any development that could not meet the Class I standard could not be approved by the Environmental Protection Agency. In response to this request, however, the MMS did develop ITL No. 7 - Air Quality Regulations and Standards, which informs lessees of their responsibilities to comply with the Clean Air Act requirements in this area.

I.C.2.b(3) Expand the Lower Kenai Peninsula Deferral

Comments on the draft EIS requested a modification to the Lower Kenai Peninsula deferral (Alternative III) that extends the area excluded from leasing to Anchor Point or Ninilchik to preserve habitat areas, fishing areas, and visual resources. (As noted previously, Anchor Point was the northern boundary of some of the deferral requests received during initial scoping for the draft EIS. Furthermore, two tracts in the area from Anchor Point to Ninilchik currently are leased.) From the information described in the following, we concluded that the request to modify Alternative III by expanding the northern boundary to Anchor Point or Ninilchik should not be included for further study.

I.C.2.b(3)(a) Expand Deferral Boundary to Anchor Point

Essentially, this request to extend the boundary of Alternative III - the Lower Kenai Peninsula Deferral to Anchor Point was evaluated in developing the boundaries for Alternative III prior to starting work on the draft EIS. We considered many factors in setting this boundary.

Basically, the potential effects to resources within an expanded deferral area are the same as those effects described in Section IV.B.3 of the draft EIS for resources within the current Lower Kenai Peninsula Deferral boundaries. Map A-2 shows that ERA 3, Outer Kachemak Bay, extends to Anchor Point. The present Alternative III deferral area encompasses the majority of ERA 3. Extending the deferral area to Anchor Point would encompass the three whole and four partial OCS tracts of ERA 3 outside the present Alternative III deferral area. As such, the area covered by the deferral increases incrementally, while the level of effects within the deferral stays the same.

I.C.2.b(3)(b) Expand the Deferral Boundary to Ninilchik

Other comments requested a possible deferral that modifies Alternative III by extending its boundaries to Ninilchik. The analysis of potential effects from the Proposed Action (Alternative I) determined that no significant effects to habitat (for example, lower trophic-level organisms and habitat, Section IV.B.1.c); visual resources (Section IV.B.1.n); commercial fisheries (Section IV.B.1.k); or sport fishing (Section IV.B.1.o) would occur in the area from Ninilchik to Anchor Point from routine operations. The analysis specifically examines the effects from an unlikely large oil spill to lower trophic-level resources and sport fishing resources (clam gathering) in the area near Clam Gulch (LS 43, Map A-3) and concluded there would be a significant impact to sport fishing in the area contacted. However, as indicated by Table A.2-15, the chance of contact from an unlikely oil spill is low, ranging from 1-2% for a platform spill and 1% or 5% from a pipeline spill. Furthermore, deferring the area may not provide additional protection, because spills contacting this land segment could originate from launch areas or pipelines outside the area deferred.

Although, for purposes of analysis in this EIS, we assume that an unlikely large oil spill occurs, the most likely number of large spills occurring from the two sales is zero. The expected absence of a large spill in part is a reflection of the emphasis that the regulations governing offshore operations place on preventing accidental releases. Moreover, our estimate of the effects of an oil spill in the draft EIS does not consider any reduction in effects that would result from oil-spill-response activities. However, the analysis of potential effects for each of the resources concluded that the stipulations and ITL's assumed to be part of the Proposed Action and all alternatives would reduce effects from routine operations and oil spills. Information to Lessee No. 3 - Sensitive Areas to be Considered in Oil-Spill-Response Plans - specifically lists the Clam Gulch Critical Habitat area and informs the lessee that oil-spill-response plans must specifically consider these areas. In fact, a site-specific oil-spill-response strategy has been developed for the Clam Gulch area and is included in the Alaska Regional Response Team's Cook Inlet Subarea Contingency Plan. The prevention provided by the regulations and the mitigation provided by stipulations, ITL's, and the site-specific response strategy provide a level of protection to the resources and land segments that is as effective as, if not superior to, that offered by deferral of the area. Therefore, extending the Alternative III boundaries to area suggested in the comment on the draft EIS would make no difference in the level of environmental effects.

I.C.2.b.(4) Expand the Barren Islands Deferral

Comments on the draft EIS requested a modification to the Barren Islands deferral (Alternative IV). Essentially, this request to extend the boundary of the Barren Islands deferral was evaluated in developing the boundaries for Alternative IV prior to starting work on the draft EIS. We considered many factors in setting this boundary. Based on the information described below, we concluded that the request to modify Alternative III by expanding the northern boundary to Ninilchik should not be included for further analysis.

Basically, the potential effects of an expanded deferral area are the same as those effects described in Section IV.B.4 of the draft EIS for resources within the current Barren Islands deferral boundaries. For example, as shown on Map A-2, ERA 6, Barren Islands, extends in an uneven arc around the islands. The OCS tracts included in the current area of the Barren Islands deferral encompass all of ERA 6 except for a sliver of two OCS tracts at the outer edge of ERA 6. Therefore, extending the Alternative IV boundaries to the area suggested in the comments on the draft EIS would make no difference in the level of environmental effects.

I.C.2.b(5) Rationale for Conclusions on Alternatives Considered but Not Included for Further Analysis

In summary, we concluded that the possible new alternatives or the modified alternatives should not be considered for further analysis for the following reasons:

- Deferring any area as a "no-rig zone" would not effectively change the overall less than significant effects from routine operations to the resources of the area identified in the comments on the draft EIS. For each environmentally sensitive area we examined, our analysis revealed that deferring an area as a "no-rig zone" does not eliminate the chance that an unlikely large oil spill could contact the environmental resource area or land segments. The prevention provided by the regulations and the mitigation provided by stipulations and ITL's provide a level of protection to the resources and land segments that is equal to, if not superior to, that offered by designation of any area as a "no-rig zone."
- Deferring an area around Tuxedni National Wilderness Area provides no greater level of protection to the air quality of the wilderness area than that provided by existing regulations. Air quality modeling indicates air emissions would be well within limits for this Class I Prevention of Significant Deterioration area.
- Modifying Alternative III - the Lower Kenai Peninsula Deferral or Alternative IV - the Barren Islands Deferral only incrementally expands the area deferred from leasing with no change to the level of effects to resources within the deferral.

A primary objective of the OCS Lands Act is to make lands available for oil and gas leasing in an environmentally acceptable manner, taking into consideration protection of the marine, coastal, and human environments. An objective we undertake to meet NEPA requirements is to write an EIS that is as straightforward and easy to understand as possible, given the inherent difficulty in estimating the uncertain potential environmental effects of uncertain potential exploration and development activities based on projections of uncertain potential leasing results of planned future sales. Given the two deferral alternatives already included for analysis, the additional four alternatives we considered but did not include for further analysis contribute little in the way of meaningful additional protection to resources. As such, including these potential new or modified alternatives would make an EIS that must cover an already complicated set of issues more complex.

We consider that the Lower Kenai and Barren Islands deferral alternatives, when combined with the other mitigating measures (stipulations and ITL clauses) analyzed in this EIS, would provide about the same level of protection of the environment as the alternatives not included for further study; however, they would allow at least some oil and gas exploration and development to proceed. For example, many of the areas recommended for deferral in the "no-rig zone for environmentally sensitive areas" deferral are either not in the Cook Inlet Planning Area (they are State of Alaska submerged lands) or have adjacent land use designations (national parks) that would restrict the placement of the onshore infrastructure needed to explore and, if warranted, develop and produce the offshore leases. Even if the development and production drilling could take place using a combination of extended-reach drilling techniques from offshore platforms placed outside the sensitive areas, the combined expense of these techniques could render the development uneconomic. Furthermore, placement of the platform away from the resource could limit the maximum recovery of the resource or necessitate the placement of more than one platform to achieve maximum recovery.

Finally, the analysis of the four alternatives (Proposed Action, no action, and two deferrals) and the stated mitigating measures cited above for natural resources that possibly could be affected by offshore exploration and development meet NEPA requirements and provide alternatives that achieve the objectives of the OCS Lands Act.

I.C.3. Mitigating Measures

I.C.3.a. Mitigating Measures Suggested During the Scoping Process

Five standard mitigating measures were adopted for Sale 149, our most recent sale in Cook Inlet. We analyzed and modified these measures as a result of scoping for Sales 191 and 199 and converted one of the standard mitigating measures to ITL No. 6. The following standard stipulations will be considered and evaluated as part of the Proposed Action and alternatives for this EIS for Cook Inlet Sales 191 and 199. The effectiveness of these stipulations is evaluated in Section II.F.1.

I.C.3.a(1) Standard Stipulations

The stipulations are considered part of the Proposed Action and all alternatives. The EIS analyzes the following four stipulations:

- No. 1 – Protection of Fisheries
- No. 2 – Protection of Biological Resources
- No. 3 – Orientation Program
- No. 4 – Transportation of Hydrocarbons

These standard stipulations are described in more detail in Section II.F.1.

I.C.3.a(2) Standard ITL Clauses

Six standard ITL clauses were adopted in Sale 149, our most recent sale in Cook Inlet. We analyzed and modified these measures as a result of the scoping process for Sales 191 and 199. The following standard ITL clauses (1 through 6) apply to OCS activities in the Cook Inlet area and are considered part of the Proposed Action and alternatives for the Cook Inlet Sales 191 and 199.

- No. 1 – Bird and Marine Mammal Protection
- No. 2 – Information on Endangered and Threatened Species
- No. 3 – Sensitive Areas to be Considered in the Oil Spill Response Plans
- No. 4 – Information on Coastal Zone Management
- No. 5 – Oil-Spill-Response Preparedness
- No. 6 – Drilling Fluids and Cuttings Discharge during Post-Lease Activities

These ITL clauses are described in Section II.F.2.

I.C.3.a(3) Additional ITL Clauses for Consideration in the EIS

The MMS decided it would be useful information to the public and future lessees to add the following optional ITL clause, No. 7 – Information on Air Quality Regulations and Standards. The ITL clause informs the lessee of the regulations in effect for the Cook Inlet area regarding the prevention of significant deterioration for air quality.

I.C.3.b. Mitigating Measures Not Considered in This EIS

No additional mitigating measures were identified by commenters during the scoping process for consideration in this EIS.

I.D. INDIAN TRUST RESOURCES

The Federal Government does not recognize the validity of claims of aboriginal title and associated hunting and fishing rights that have been asserted for unspecified portions of the sale area. Therefore, the MMS anticipates that the Proposed Action or alternatives will have no significant effects on Indian Trust

Resources. While the Department of the Interior does not recognize these resources as Indian Trust Resources, this EIS considers the potential effects of lease-sale activities on Native Alaskan communities as they relate to economics, subsistence-harvest patterns, sociocultural systems, and environmental justice. The MMS consults with federally recognized tribes consistent with the Presidential Executive Memorandum dated April 29, 1994, on Government-to-Government Relations with Native American Tribal Governments; Executive Order 13175 dated November 6, 2000, on Consultation and Coordination with Indian Tribal Governments; and the January 18, 2001, Department of the Interior-Alaska Policy on Government-to-Government Relations with Alaska Native Tribes.

The MMS scheduled government-to-government meetings for December, coincident with the release of the draft EIS and start of the comment period but before the public hearings, with the tribes that we determined could be substantially and directly affected by the proposed action: Ninilchik Village Tribe, Seldovia Village Tribe, Native Village of Port Graham, and the Native Village of Nanwalek. Government-to-government meetings were held with the Tribal governments of Ninilchik and Seldovia on December 16, 2002. Weather prevented access to Port Graham and Nanwalek for meetings scheduled on December 17, 2002. The rescheduled meetings with Nanwalek and Port Graham were held on January 30, 2003. The following summaries of the meetings were prepared by MMS staff. We received written comments from the Ninilchik and Port Graham tribal governments. The comments and responses to the comments are included in Section VII of the EIS. Summaries of the government-to-government meetings are presented in below.

In addition to the government-to-government meetings, we solicited comments from other tribes that may not be substantially and directly affected but that may have concerns regarding the proposed action and potential effects. The MMS sent the draft EIS and the *Federal Register* notice of availability that specifies how written comments could be sent to the MMS to the Tribal offices for Chickaloon, Eklutna, Kenaitze, Knik, Salamantof, and Tyonek. This mailing was followed by a letter to each office that explained that while we had not scheduled consultation with the tribes, we nonetheless encouraged their comment. The letter pointed out that we had scheduled public hearings in Anchorage, Seldovia, Homer, and Kenai and that we had scheduled a teleconference public hearing and specifically encouraged those in remote area to use this opportunity to submit verbal testimony. We received written comments from the Eklutna and Chickaloon Tribal governments. The comments and responses to the comments are included in Section VII of the EIS. Also, the Eklutna Native Village Tribal Council requested government-to-government consultation, which was held on April 28, 2003. We received input from the Kenaitze Indian Tribe IRA Council regarding the EIS air-quality analysis. Their input was considered under government-to-government consultation but does not appear in Section VII, Response to Comments, since the input was received after the close of public comments.

Tribal offices on Kodiak Island—Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions—and on the Southern Alaskan Peninsula—Chignik, Chignik Lagoon, Chignik Lake, Ivanoff Bay, and Perryville—received the draft EIS and the Notice of Availability. Comments were not received from any of these tribes. We sent the draft EIS and Notice of Availability to the Chugachmuit Environmental Consortium, a forum for the environmental concerns of Cook Inlet and Prince William Sound area Tribes.

Libraries serving the aforementioned tribal villages received copies of the draft EIS and Notice of Availability.

I.D.1. Summary of Ninilchik Village Tribe Government-to-Government Meeting

Ninilchik Traditional Council Attendees: Bruce Oskolkoff (President), Ivan Encelewski (Executive Director)

MMS Attendees: John Goll (Alaska OCS Region Director, Anchorage), James Lima (EIS Coordinator, Anchorage), Mike Burwell (Socioeconomics Specialist, Anchorage), Albert Barros (Community Liaison, Anchorage)

Albert Barros opened the meeting by explaining that government-to-government meeting was being conducted in accordance with Executive Order 13175. He encouraged the tribe to review the draft EIS, which they had received, and to submit written comments.

The MMS staff provided the tribal attendees and others copies of the *Federal Register* Notice of Availability and an addendum regarding a change in the date and time of the Kenai public hearing, the February 11 close of public comments, and the teleconference hearing. We provided copies of the Cook Inlet draft EIS Executive Summary and the draft EIS on CD-ROM for members of the Tribal Council.

The MMS staff gave a brief overview of the scenario used to analyze effects of the sale, provided a section-by-section overview of the EIS, reviewed the four alternatives analyzed within the document, and explained how both sales were covered by a single document, emphasizing that Sale 199, if held, would require a full NEPA process with consultation. We noted that while the draft EIS did not identify an agency-preferred alternative, the final EIS would contain a preferred alternative that could contain none, one, or both of the deferral options. We noted that additional areas for deferral could be identified as part of the public comment process. If the Secretary of the Interior decides to proceed with each of the sales (191 and 199) by not choosing Alternative II - No Lease Sale, the Secretary may chose one, all, some combination, or part of the deferral options to comprise the Final Notice of Sale for Sale 191. Finally, we reviewed the general effects of any action by alternative. Discussion included the new concept of the opportunity index, the potential for royalty suspensions on initial volumes of oil from new production, and that the Protection of Fisheries stipulation encompassed subsistence activity as well as commercial and sport fishing.

Bruce Oskolkoff noted the deferral areas are important to the tribes because of the resources that each contains. We outlined the process by which determinations would be made on what areas were included in the lease sale. The Tribe would like to receive any exploration plan that may result from the lease sale. We indicated these could be provided, except for proprietary information the company might include in the plan. Further discussion centered on discharges of drilling muds, cuttings, and produced water into the marine environment. We explained the basis for the assumption in the scenario that these discharges would not occur from development and production. We explained how the Environmental Protection Agency's National Pollution Discharge Elimination System (NPDES) permit system would constrain exceptions to the "zero discharge" assumption. The tribes are working with the Environmental Protection Agency on the issue of NPDES permits.

I.D.2. Summary of Seldovia Village Tribe (Indian Reorganization Act) Government-to-Government Meeting

Seldovia Village Tribe Attendees: Don Kashevaroff (President), Helen Quijance (Council Member), Patti Lu Hansen (Council Member), Trinket Gallien (Assistant Director)

MMS Attendees: John Goll (Alaska OCS Region Director, Anchorage), James Lima (EIS Coordinator, Anchorage), Mike Burwell (Socioeconomics Specialist, Anchorage), Albert Barros (Community Liaison, Anchorage)

Albert Barros opened the meeting by explaining that government-to-government meeting was being conducted in accordance with the Executive Order 13175. He encouraged the tribe to review the draft EIS, which they had received, and to submit written comments.

The MMS staff provided the tribal attendees and others copies of the *Federal Register* Notice of Availability and an addendum regarding a change in the date and time of the Kenai public hearing, the January 21, 2003 date for the Seldovia public hearing, the February 11 close of public comments, and the teleconference hearing. We provided copies of the Cook Inlet draft EIS Executive Summary and the draft EIS on CD-ROM for members of the Tribal Council.

The MMS staff gave a brief overview of the scenario used to analyze effects of the sale, provided a section-by-section overview of the EIS, reviewed the four alternatives analyzed within the document and explained how both sales were covered by a single document, emphasizing that Sale 199, if held, would require a full

NEPA process with consultation. We noted that while the draft did not identify an agency-preferred alternative, the final EIS would contain a preferred alternative which could be one of five options: (1) offer entire area for lease; (2) have no lease sale; (3) offer area except Kenai deferral; (4) offer sale area except Barren Islands Deferral; (5) offer sale area except Kenai deferral and Barren Islands Deferral. We noted that additional areas for deferral could be identified as part of the public comment process. Finally, we reviewed the general effects of action by alternative.

Discussion centered on the likelihood of an oil spill and the effects of the *Exxon Valdez* oil spill. Questions were raised regarding training for the local oil-spill-response team. The Tribe would like information on the NPDES process as it becomes available.

I.D.3. Summary of Nanwalek Village Tribe Government-to-Government Meeting

Nanwalek Attendees: 46 persons from the community and students from the high school

MMS Attendees: John Goll (Alaska OCS Region Director, Anchorage), Fred King (Chief, Environmental Assessment, Anchorage), Albert Barros (Community Liaison, Anchorage)

The high school students posted several posters indicating their concerns for oil spills and indicating a preference against the sales.

At the beginning of the meeting, several participants asked: "How much of what they say in the meeting will be included in the Environmental Impact Statement and in the decisions that follow." The MMS explained that all EIS comments would be considered, and any comment about the substance or issues covered in the EIS would receive a response in the EIS. Comments regarding their preferences about holding the sale would be considered in the Record of Decision.

The MMS provided an overview of the MMS government-to-government meetings, a discussion of the OCS leasing process, the NEPA process, Coastal Consistency, and the OCS lease-sale decision process. The MMS explained the Proposal, no action alternative, the two deferral alternatives, and the proposed mitigating measures, with an explanation of each proposed stipulation.

Attendees at the meeting voiced their concern that potential oil spills could adversely affect their subsistence life, culture, and community life style. They expressed their concerns that potential adverse effects to subsistence are their number-one concern. They stated the effects of an oil spill near Nanwalek would "have a devastating effect." These effects cause stresses in the community and to the people living in Nanwalek. They expressed concern that the effects in the EIS were understated. They want the MMS to prevent the oil industry in State waters in upper Cook Inlet from dumping and disposing wastes into the waters of Cook Inlet. The people in the village stated: "they care about the land, their children and their future."

They stated a preference for alternative forms of energy, rather than oil development. They stated that they are against the oil development in Cook Inlet but, if it must happen, the subsistence area used by the community should receive protection in case of an oil spill. The MMS should require local hire, and the people in Nanwalek should be trained to respond to oil spills and become employees of the oil company. If the sale proceeds, the size of the sale should be reduced.

I.D.4. Summary of Port Graham Village Tribe Government-to-Government Meeting

Port Graham Village Attendees: Village Council: Pat Norman (Chief), Debbie McMullen, Agnes Miller (Secretary), and Elenore McMullen (retired chief). Staff: Violet Yeaton (Environmental Planner), Wes Breedlove (Environmental Technician), Karen Moonin (Solid Waste Program), Paul McCollum (PGVC Consultant), Fran Norman (Tribal Administrator), Vera Wright (Administrative Assistant). Environmental Health Committee: Bob Huntsman, Ephim Anahonak Jr., Peter Anahonak Sr., Melvin Malchoff, Stella

Meganack. Community: Jenny Tanape, Greg McMullen, Tom Sawden, Billy Meganack, and Richard Moonin, 8th-10th grade students. Guests: Christine Celentano/Env. Director/Chugachmiut, Bob Shavelson/Cook Inlet Keeper

MMS Attendees: John Goll (Alaska OCS Region Director, Anchorage), Fred King (Chief, Environmental Assessment, Anchorage), Albert Barros (Community Liaison, Anchorage)

Conversations with the Traditional Council and tribal members included consultation issues, water quality and discharges into the marine environment, areas studied as alternatives in the EIS, and subsistence resources.

Consultation between the Tribe and the MMS was discussed. The Village Council defines meaningful consultation as the ability to impact the decisionmaking process. Other issues affecting consultation, such as the decisionmaking process, permitting of activities, and the complexity of the EIS, should be understood prior to face-to-face meetings. The Council expressed a desire for more consultation and discussion on consultation, recognizing that disagreements on the Proposed Action should not limit the working relationship between the Tribe and the MMS. The Council wants assurances that their concerns will be considered by the MMS. The MMS noted that the Council has the same opportunity as the State of Alaska to comment on the EIS. The Council requested consultation with the Secretary of the Interior.

The MMS provided an overview of the EIS, noting lease sales were tentatively planned for 2004 and 2006. The EIS envisions that any production that might result from the lease sales will be used in Southcentral Alaska.

Water-quality issues from discharge into the marine environment of drilling muds, cuttings, and produced water is a major concern. The Council asserts that MMS has the authority to require "zero discharge" of these substances. The MMS notes regulation of discharges is the responsibility of the Environmental Protection Agency, which declined an invitation to be a cooperating agency for developing the EIS. The MMS received a request from the Council for information regarding the Environmental Protection Agency and zero discharge on exploration and development and production activities.

The Council requested two deferrals based on input from their Environmental Health Committee. The MMS explained the process for determining the boundaries for the Lower Kenai Peninsula Deferral (Alternative III) and the Barren Islands Deferral (Alternative IV) analyzed in the EIS and why they are not the same as those proposed by the Village Council.

Subsistence information presented in the EIS was discussed. The Tribe sees contamination in foods and questions whether adequate baseline data exist to draw conclusions in the EIS. The MMS responded that it does have an adequate baseline. The Council suggested that a study is needed to determine if carcinogens discharged into Cook Inlet are causing cancer. It is not clear if the Indian Health Service has a cancer registry for Cook Inlet.

Miscellaneous items discussed at the meeting included tug escort for laden oil vessels, the use of traditional knowledge, and upcoming MMS meetings on the Environmental Studies Program.

I.D.5. Summary of Native Village of Eklutna Tribe Government-to-Government Meeting

Native Village of Eklutna Attendees: Lee Stephan, (Village Chief Executive Officer), Melisa Charmley, (Tribal Council Member) Maria Coleman (Tribal Council Member), Marc Lamoreaux (Natural Resource Director), Guy Stephen (Tribal Member), Bob Shavelson (Cook Inlet Keeper, by telephone)

MMS Attendees: Paul Stang (Regional Supervisor, Leasing and Environment, Anchorage), Fred King (Chief, Environmental Assessment, Anchorage), Albert Barros (Community Liaison, Anchorage), Richard Prentki (Environmental Studies, Anchorage)

In their comments to the draft EIS, the Native Village of Eklutna requested a meeting with MMS pertaining to their concerns and issues about the proposed OCS lease sales. Mr. Lee Stephan welcomed MMS attendees to their village and thanked them for coming. He stated that they have concerns that the proposed

OCS lease sale in Cook Inlet could affect their village. They also are concerned about the cumulative effects of other non-MMS activities in neighboring communities (Anchorage, Kenai, Wasilla, etc.) such as dumping sewer wastes into the Inlet. They stated the information about whales may be skewed because recent sampling depended on harvests by subsistence hunters, and hunters do not harvest old or sick animals. He indicated that the number of outboard engines could affect the hearing of fish and beluga whales.

Mr. Stephan noted that fish school up around Kalgin Island as part of their migration into the rivers in upper Cook Inlet. Mr. Stephan stated the village is concerned about seismic effects on fish and whales. They would like to have all government agencies speak with one voice. The current permitting system is very complex and difficult for Tribes to work with and to understand who is "responsible" for permitting activities and enforcing laws and regulations. He said that he can understand giving a waiver (the Environmental Protection Agency's Cook Inlet Exemption NPDES Permit) to those who do well in protecting the environment, but not to those who do not.

The MMS provided information about completed water-quality studies pertaining to the Cook Inlet waters and their findings. Their concerns about wastes, especially those from larger neighboring communities, were discussed. The MMS also provided information about potential passive acoustic monitoring for Cook Inlet that has been successfully used in the Beaufort Sea. The MMS discussed the conduct of government-to-government consultation. Compensation under current oil-spill compensation laws was discussed.

Ms. Maria Coleman explained that the village leaders are discouraged by the complexity of the permitting and decision processes involved. that no single Federal Agency is responsible for the permitting of projects, and Federal Agencies are always saying that it is the responsibility of some other Federal Agency. The government agencies give the Native Village of Eklutna the "run around," which is a roadblock to the public and should not become the responsibility of the Tribe and public to correct. Ms. Coleman felt she should not have to be a lawyer to understand the regulations (because they are so complex). The text should be simplified and her comments should count, whether they are given to the Environmental Protection Agency, the State, or whomever. The Tribes have original use. We are working towards zero discharge. The MMS should not do only what is minimal, the MMS should do more than that.

The Eklutna attendees made specific suggestions for consideration by the MMS for future studies about contaminants and marine mammal tissue sampling. They believe that the current mitigation is inadequate and request a zero-discharge requirement for exploration in addition to production. They requested funding for staffing and for an oil-spill-pollution fund specific for the Tribe. They suggested that an "exclusion zone" should have been considered but did not offer any further specifics.

The MMS have reviewed the above comments. The MMS acknowledges that subsistence resources harvested by the Village of Eklutna migrate and use the Cook Inlet area. However, the level of effects from routine activities from the Proposed Action is not expected to reach or exceed the significance threshold as defined for this EIS.

Because the Tribe has requested that the MMS to meet with their representatives, the MMS will continue to discussions with the Village of Eklutna throughout the remainder of the prelease process.

I.E. EXECUTIVE ORDER 12898 ENVIRONMENTAL JUSTICE

The Presidential Executive Order on Environmental Justice requires agencies to incorporate environmental justice into their missions by identifying and addressing environmental effects of their proposed programs on minorities and low-income populations and communities. The Department of the Interior has developed guidelines in accordance with Presidential Executive Order 12898. The MMS participated in the development of these guidelines. The MMS's existing process of involving all affected communities and Native American and minority groups in the NEPA compliance process meets the intent and spirit of the Executive Order. However, we are continuing to identify ways to improve the input from all Alaskan residents, not only by commenting on official documents but also by contributing their knowledge to the scientific and analytical sections of the EIS.

The initial scoping process, government-to-government consultation, public hearings, and comments on the draft EIS revealed general environmental concerns and specific Environmental Justice concerns of low-income and minority populations in the Cook Inlet Shelikof Straight area.

The initial scoping process, which occurred prior to the draft EIS, consisted of public input and meetings in cities and villages, government-to-government meetings with tribal councils in the villages, and MMS staff analysis of issues from past lease sales and information developed in the MMS Environmental Studies Program. Section I.C describes the issues identified during scoping and Appendix F contains the Scoping Report.

We met with the public in Homer on January 30, 2002; in Seldovia on January 31, 2002; Nanwalek on February 8, 2002; and in Port Graham on February 11, 2002. (Public meetings in Ninilchik, Kodiak, and a toll-free phone-in session were held, but no input from the public was received.)

Coincident with the public meetings, we met in separate government-to-government consultation with the Seldovia Village Tribe Indian Reorganization Act Council on February 1, 2002; with the Nanwalek Village Indian Reorganization Act Council on February 8, 2002; with the Ninilchik Traditional Council on February 8, 2002; and with the Port Graham Village Indian Reorganization Act Council on February 11, 2002.

Initial scoping and followup input revealed that potential Environmental Justice impacts of proposed Sale 191 on low-income, minority populations in the Cook Inlet/Shelikof Strait area would focus on the Native, subsistence-based communities of the region. For example, this input revealed the importance of subsistence resources in the lower Kenai Peninsula, especially the Port Graham-Nanwalek Area Meriting Special Attention (AMSA). We used this input in developing Alternative III, the Lower Kenai Peninsula deferral. This deferral, along with the Barren Island deferral, is incorporated into the agency-preferred alternative. We also included the Port Graham-Nanwalek AMSA in ITL No. 3 - Sensitive Areas to be Considered in the Oil-Spill-Response Plans. Similarly, our meeting with the Ninilchik Tribal Council members resulted in the identification of the Alaska Native Health Board reports, which we incorporated into the analysis of potential effects of the proposed action.

The MMS maintains a dialogue on Environmental Justice with these communities. As outlined in Section I.D, the MMS scheduled followup meetings to address Environmental Justice issues and other issues coincident with the release of the draft EIS and the start of the comment period, but before the public hearings, with the tribes that we determined could be substantially and directly affected by the Proposed Action: Ninilchik Village Tribe, Native Village of Seldovia, Native Village of Port Graham, Native Village of Nanwalek. Government-to-government meetings were held with the Tribal governments of Ninilchik and Seldovia on December 16, 2002. Weather prevented access to Port Graham and Nanwalek for meetings scheduled on December 17, 2002. The rescheduled meetings with Nanwalek and Port Graham were held on January 30, 2003. Section 1.D presents summaries of these meetings. In fact, many of these meetings involved tribal members as well as tribal government officials. In addition, as outlined in Section I.D, we also solicited input from tribes in the area that we identified as not being directly and substantially affected by the Proposed Action.

In addition to this government-to-government consultation and other tribal government contacts, MMS directly and indirectly elicited input from minority communities and populations. As noted previously, many of our government-to-government meetings involved tribal members. As noted in Section VI, the draft EIS and instructions for comment were sent to the libraries in rural communities and to non-governmental organizations, such as Native corporations and associations, that represent the interests of tribal members. To facilitate widespread distribution of the draft EIS, we made it available in a variety of formats including printed, bound volumes, Adobe Acrobat files available on a CD-Rom or downloadable via the MMS web site, and as web pages on our web site. We held public hearings on the draft EIS in Anchorage, Seldovia, Homer, and Kenai-Soldotna at times (evenings and weekends) and locations accessible to the general, minority, and low-income population. To facilitate input from rural populations, we conducted a toll-free phone-in public hearing.

Our analysts made use of a variety of contemporary databases and published studies that document the concerns of minority populations in the area. The MMS Environmental Studies Program generated a great deal of ethnographic and other information on the Southcentral Alaska inhabitants. For example, the

MMS-sponsored study *Long-Term Consequences of the Exxon Valdez Oil Spill for Coastal Communities of Southcentral Alaska* (Fall et al., 2001) examined characteristics and perspectives of many of the communities in the Sale 191 area and produced extensive ethnographies for the region. Similarly, use of databases, such as the Alaska Department of Fish and Game Whiskers! database, reveals the Environmental Justice concerns without placing the burden of repeated response on members of minority and low-income populations. We removed direct attribution of these comments in the EIS when the Native Village of Port Graham requested that we do so in order to ensure the anonymity of the respondents.

The potential effects of sale activities on the issues raised by these concerns are addressed in Sections III.C.7 and IV.B.1.p on Environmental Justice.

I.F. THE NATIONAL ENVIRONMENTAL POLICY ACT PROCESS FOR SALES 191 AND 199

We are using a different approach in both format and structure for this lease-sale EIS than we used for previous EIS's for the Cook Inlet area. This section details why and how this difference came about and the advantages we see from this change. We also have used this approach in the most recent multiple-sales EIS for the Beaufort Sea. Preparing the Beaufort Sea EIS did not set a precedent. The MMS Gulf of Mexico Region has been publishing single, multiple-sales EIS's for the last two 5-year oil and gas leasing programs. Also, the Northeast National Petroleum Reserve-Alaska EIS, which was completed in August 1998, was used for more than one sale. Similarly, the State of Alaska has used its Cook Inlet Areawide 1999 Oil and Gas Lease Sale Environmental Analysis and Findings to support yearly areawide lease sales through 2002 (State of Alaska, Dept. of Natural Resources, 1999, 2002).

Once a lease sale is held within a particular geographic area, the results of scoping for subsequent lease sales within the next several years tend to reflect industry interest and the comments received on the initial sale in the same area. This initial multiple-sale EIS addresses the overall concerns expressed by local, State, Federal, and public reviewers in addition to issues addressed within the specific EIS. Additional lease-sale proposals and NEPA documentation covering the same geographic area further may clarify issues; however, much of the text of both comments received and EIS's written repeat the text of previous documents already in the public domain. Over the years, reviewers have expressed reluctance to review and comment on a NEPA document that looks very similar to the one they just reviewed. Also, indications of industry interest show that in subsequent sales within a geographic area, interest generally declines if exploration is unsuccessful, because the most likely prospects are leased and explored first. This is based on the fact that there have been no big discoveries on the Cook Inlet OCS. If such a discovery is made as a result of a sale, this trend could reverse.

Within the Cook Inlet Planning Area, the MMS Alaska OCS Region has held three oil and gas lease sales: CI (1979), 60 (1982), and 149 (1997). In CI, 102 leases were issued as a result of those sales, and 13 exploration wells were drilled. The NEPA documentation conducted for these lease sales included a draft and final EIS for each action, making a total of six EIS documents in the public domain written for activities in Cook Inlet. In addition, since 1959, the State has held 44 oil and gas lease sales covering approximately 6 million acres of submerged land, tideland, and upland areas of the Cook Inlet. After declining in recent years, industry interest in the Cook Inlet area is increasing.

Although this EIS addresses two proposed sale actions, one sale decision will be made in 2004 and the other in 2006. A Call and NOI were issued at the beginning of the prelease process to explain the multiple-sale approach for the EIS. The Area Identification selected the same area identified in the 5-year program for 2002-2007. A separate Area Identification will be conducted for Sale 199. A Notice of Sale will be issued for the each sale after completion of the final NEPA document for each sale.

If the Secretary of the Interior decides to proceed with each of the sales (191 and 199) by not choosing Alternative II - No Lease Sale, the Secretary may chose one, all, some combination, or part of the deferral options to comprise the Final Notice of Sale for Sale 191. The Secretary will have the full suite of options available for Sale 199 when that decision is made in 2006. The Secretary may choose the same options selected for Sale 191 or different options.

For purposes of analysis, in this EIS we assume that while exploration will follow both lease sales, a single discovery of a single field containing 140 million barrels of crude oil and 190 billion cubic feet of natural gas will result from either or both lease sales. See Appendix B - Exploration and Development Scenarios for a more detailed discussion of this concept. Exploration and development activities under this EIS could take place in any part of the area from any of the proposed sales.

Preparing a multiple-sales EIS enables us to conduct the prelease decision processes for subsequent sales (Sale 199) more efficiently, consistent with Executive Order 13212 issued on May 18, 2001, to expedite energy-related projects. This EIS incorporates by reference previous EIS's and updates existing text and data, with emphasis on new information since the last EIS was written, and explain the multiple-sales process.

Before starting the process for Sale 199, the MMS will initiate consultation with the public. An Information Request will be issued, specifically asking for input on the scheduled sale being considered. A NEPA review will be conducted for Sale 199. An Environmental Assessment will be prepared to determine whether the information and analyses in this EIS are still valid for Sale 199. The Environmental Assessment will focus on new information, data, or both since publication of this EIS. Consideration of the Environmental Assessment and any comments received in response to the Information Request will result in either a Finding of No Significant Impact (FONSI) or a determination that a supplemental EIS is warranted.

Because the Environmental Assessment prepared for Sale 199 is for a Proposed Action that "is, or is closely similar to, one which normally requires the preparation of an EIS" (40 CFR 1501.4[e][2]), a FONSI will be available for public review for 30 days before a decision is made. The Environmental Assessment and FONSI will be sent to the Governor of the State of Alaska and its availability announced in the *Federal Register*. The FONSI will become part of the Record of Decision prepared for the decision on the Notice of Sale.

Some of the factors that could justify a supplemental EIS are significant changes in resource estimates, significant new information, significant new environmental issue(s), or a significant change in the Proposed Action. A supplemental EIS would focus on addressing any additional significant issues and analyses.

I.F.1. Sale 191 Process

This EIS includes an assessment of alternatives and cumulative effects. The cumulative-effects analysis evaluates the contribution of Alternative I for Sale 191 to the past, present, and reasonably foreseeable activities, including State and Federal onshore and offshore activities in the Cook Inlet area. Sale 199 is evaluated as part of those reasonable or foreseeable activities. The cumulative effects of Alternatives III and IV for Sale 191 are expected to be essentially the same as those for Alternative I for Sale 191 and Alternatives I, III, and IV for Sale 199. This is because the potential effects of each of these alternatives for both sales are based on the same oil and gas resource level. Also, each sale would affect the same physical, biological, and human resources, in the same area, within the 5-year period. Slight differences may occur in the contributions to cumulative effects from the various alternatives of the two sales. However, they are so small relative to the overall cumulative effects to which they are being compared that they cannot be meaningfully measured.

For purposes of analysis, we defined the production volumes expected from leasing in the program area. Anticipated production and associated activities are analyzed based on economic resource estimates established at the beginning of the 2002-2007 Five-Year Program. The EIS analyzes the effects of exploration, development, and production quantitatively to the degree possible, using different economic and development scenarios individually for each sale. Impacts that cannot be estimated quantitatively are estimated qualitatively. The EIS analyses will be used by reference as the basis for the analyses in the Environmental Assessments or supplemental EIS's prepared for subsequent Sale 199 in the planning area during the 2002-2007 Five-Year Program.

The description of activities to take place is broad enough to encompass the resources and activities expected for either of the two sales. The scenario covers the resources and activities that are likely to result from the proposed actions. The later sale will be subject to an Environmental Assessment or supplemental EIS. This EIS assumes that standard mitigating measures are in place as part of the Proposed Action; the EIS will assess the effects of possible new mitigating measures added to existing standard mitigating measures. The effects will be analyzed quantitatively (if possible) or qualitatively. Oil-spill-modeling runs will be conducted for the program area.

Based on the results of the scoping process, alternatives are analyzed that defer certain blocks from the sale. Alternatives are evaluated by comparing changes in resource production and environmental effects relative to the entire program area. Alternative I for each sale includes all the blocks in the Cook Inlet Planning Area, as defined in the 2002-2007 Five-Year Program. The final EIS identifies the agency-preferred alternative.

As described in Appendix B, the MMS resource-assessment models are designed around the concept that the entire area is open for exploration. The model identifies and tests all prospects to determine their commercial viability. To support this approach, the EIS clearly describes the inherent uncertainty in estimating undiscovered resources, and the fraction of this unknown volume likely to be discovered and developed relative to perceived industry interest and effort. This uncertainty is magnified by the uncertainty associated with estimates of the environmental and socioeconomic effects resulting from the assumed exploration and development scenarios. The EIS also discusses the accuracy of resource estimates for the various alternatives or limited number of sales.

The EIS evaluates the biological effects as required under the Endangered Species Act, including all exploration activities in the Cook Inlet Planning Area for Sales 191 and 199. The draft EIS, which also gave our Biological Evaluation, was submitted to the National Marine Fisheries Service and the Fish and Wildlife Service to initiate formal consultation. The National Marine Fisheries Service issued a new Biological Opinion dated March 31, 2003, that included all OCS leasing and exploration activities for Sale 191. The Fish and Wildlife Service concluded that formal consultation was not necessary for the proposed sales and subsequent exploration activities.

The EIS also includes analysis of essential fish habitat and consultation that covers leasing and exploration activities for both sales.

I.F.2. Processes for Subsequent Sale 199

After Sale 191 is held, if it is held, the MMS will decide whether to initiate the planning process for the next sale with an Environmental Assessment and, if warranted, a supplemental EIS. The MMS will review current issues and new information (for example, if the preferred alternative changes,) and, if that review results in no significant change from those addressed in the multiple-sale EIS, the MMS will prepare an Environmental Assessment and issue a FONSI. If that review results in new issues or sufficient new information not addressed in the multiple-sale EIS, the MMS will prepare a supplemental EIS. As soon as the decision is made, the MMS will announce its intention to prepare either an Environmental Assessment or a supplemental EIS through a press release or mailout and will issue a *Federal Register* notice.

I.G. STREAMLINING STATEMENT

Readers of this multiple-sale EIS are alerted to some differences in this EIS from previous Alaska OCS Region EIS's. While this EIS is more complicated in that it addresses two sales, we have tried to streamline the EIS to provide a more concise, reader-friendly, and useful analysis of potential effects and impacts of proposed activities. We are continuing to attempt to streamline our EIS.

We have attempted to eliminate much of the repetition from previous EIS's. We analyze the most recent, relevant information and incorporate background information by reference, when appropriate, providing only a concise summary for text continuity.

Streamlining follows the intent of the Council on Environmental Quality regulations in 40 CFR 1502.21, which encourage agencies to incorporate material by reference into an EIS to decrease volume without impeding agency analysis and public review of the action being considered. In this EIS, we cite the incorporated material and briefly describe its content. All material incorporated by reference is reasonably available for inspection by interested persons within the public comment period and is available in local libraries and from the MMS Alaska OCS Regional Office.

I.H. IMPORTANT DIFFERENCES BETWEEN THE DRAFT EIS AND THE FINAL EIS

The following summarizes some of the more important aspects of the final EIS and changes that have been made as a result of public review of the draft EIS.

- Section VII contains the comments we received on the draft EIS through letters, postcards, faxes, and e-mails and testimony at public hearings, and presents our response to those comments. We received many substantive comments on many aspects of the Proposed Action and of the resources analyzed in the EIS, such as water quality, endangered and threatened species, fisheries resources, commercial fishing, and subsistence-harvest patterns. Many comments resulted in presentation of additional information, as indicated by our response to the comment, and revisions were made to the appropriate text in the final EIS. For example, as a result of the comments, we added information regarding the potential effects of onshore pipeline construction to the Effects from Routine Operations analysis in Sections IV.B.1.a through IV.B.1.r; added an explanation on incorporation of traditional knowledge in Section I.C.1.b(4); added information on aquatic farms and fish hatcheries in Section III.C.2; and explained the MMS process for ensuring input from affected communities for Environmental Justice in Section I.E.
- Section I.C describes how we developed the alternatives analyzed in the EIS and describes and analyzes the potential new and modified alternatives suggested in the public comments on the draft EIS. After thorough review, the alternatives analyzed in the draft EIS stayed the same; no new additions or deletions were included.
- Section I.D contains summaries of government-to-government meetings with Ninilchik Village Tribe, Port Graham Village Tribe, Nanwalek Village Tribe, Seldovia Village Tribe, and Eklutna Village Tribe.
- ITL No. 7 - Air Quality Regulations and Standards was added to Section II.F to address comments regarding potential air quality effects to the Tuxedni National Wilderness Area.
- As required by NEPA regulations of the Council on Environmental Quality, MMS identified the agency-preferred alternative for Sale 191, which is the combination of Alternative III - the Lower Kenai Deferral and Alternative IV - the Barren Islands Deferral, including all stipulations and ITL clauses described for Alternative I - the Proposed Action. Many of the public comments on the draft EIS supported deferral of these areas. We added information regarding the agency-preferred alternative to Section I.C and II.G, Table I.A-1 and II.B-3, and Figure I.A-2 of the final EIS.
- Information was added to Appendix B regarding the assumption of no discharge, the high-case scenario, and effect of incentives on the hypothetical scenario.
- The Biological Opinion and other correspondence were added to Appendix C - Endangered Species Act Section 7 Consultation and Coordination.
- The Essential Fish Habitat programmatic consultation document and correspondence were added to Appendix D.
- Air quality modeling information was added as Appendix H - Air Quality Modeling for Cook Inlet Sale 191 and 199.

SECTION II

ALTERNATIVES INCLUDING THE PROPOSED ACTION

CONTENTS OF SECTION II

II. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

This section discusses the sale approach and structure (Section II.A); the resource estimates, development scenarios, and summary of effects for each of the two sales covered in this environmental impact statement (EIS) for the Proposed Action, Alternative I (Section II.B); the No Lease Sale Alternative (Section II.C); and each of the deferral alternatives to the Proposed Action (Sections II.D and II.E). Section II.F discusses the effectiveness of the stipulations and Information to Lessee (ITL) clauses as mitigating measures. Section II.G describes the Agency-Preferred Alternative.

II.A. APPROACH TO ANALYSIS AND OIL AND GAS RESOURCE POTENTIAL

II.A.1. Approach to Analysis

This EIS encompasses the two proposed sales (191 and 199) that are being considered for the 2002-2007 Five-Year Program (final). For purposes of analysis, the Minerals Management Service (MMS) assumes that exploration would result from both sales. This exploration, from either or both sales, would lead to the discovery and development of a single field. Section II.B - the Proposed Action contains the details of this exploration and development scenario. Appendix B presents additional description and analysis that provides the rationale and basis for the resource estimates and the exploration and development scenario. Section IV.B presents a discussion of potential developmental effects for the proposed actions and for alternatives. Section V contains the cumulative-effects analysis.

Section II.B indicates that the activities associated with the two sales—leasing, exploration, development, and production—could take place anywhere in the Cook Inlet Planning Area, although the expected location is the central to northern portions of the sales area. (When we use the term “estimate” in this EIS, we are indicating what would be expected if the scenario we constructed for evaluation purposes actually happened. Similar scenarios in past EIS’s generally have not been realized.) Nevertheless, past experience onshore and in State waters has shown that exploration and subsequent development will expand into more remote and higher cost areas after opportunities are largely exhausted in areas more readily accessible from existing infrastructure.

II.A.2. Oil and Gas Resource Potential

If commercial discoveries are found and developed, crude oil and natural gas production is expected as a result of these two proposed lease sales. For purposes of analysis, we assume that 140 million barrels of crude oil and 190 billion cubic feet of natural gas could be discovered and produced from a single development resulting from either or both sales. As explained in Appendix B, we base the Proposed Action analysis on this field size to provide consistency with the previous 5-year program EIS analysis while recognizing the field characteristics of the area and industry interest.

Table I.A-1 indicates that Alternative III defers 34 blocks and Alternative IV defers 36 blocks, which leaves 481 blocks in the proposed sales area under Alternative III, and 483 blocks for lease under Alternative IV, should either deferral be selected. The table also indicates the Opportunity Index, which is shown as a percentage and represents the probability that a commercial field could be leased, drilled, discovered, and developed in the area offered for leasing under each alternative, is about 99% for each deferral. Conversely, the Lost Opportunity in the table indicates that there is a very low chance, approximately 1%, that a commercial field could be leased, drilled, discovered, and developed in each deferral area. No one can accurately define the location of future oil fields. Because commercial oil resources are not uniformly distributed, oil pools covered by only a few tracts could contain all of the economically recoverable reserves in the sale area. The remainder of the area could either lack the geological attributes to produce large oil pools or have other conditions that would preclude commercial viability. This resource estimate reflects the MMS's current data and knowledge. Individual companies could have a much different view of the oil potential in the Cook Inlet outer continental shelf (OCS). Future leasing patterns may reflect different industry views regarding the possible location of commercial-sized fields in the program area.

The locations of future commercial offshore fields that presently are undiscovered are impossible to predict without exploration drilling. Petroleum-assessment models statistically analyze the geology and engineering characteristics of the area to determine the total resource volume that is expected to be economically viable to produce if discovered. While these total resource estimates are valid on a regional scale, they cannot be subdivided into smaller fractions and still be meaningful as real volumes of oil. However, a risk-weighting method can be used to define the chance that the resource volume will occur in a particular subarea.

We use the term "Opportunity Index" to describe that risk-weighted probability. To understand the index, suppose, for example, that an OCS area contained a total of 500 million barrels of economically recoverable oil in any of five prospects. Suppose, also, that each prospect is the same size and equally likely to contain recoverable oil. The risk-weighted volume assigned to each prospect would be 100 million barrels. The Opportunity Index assigned to each prospect would be 20%. This means that there is a 20% chance (or one-in-five chance) that 500 million barrels could be discovered in any single prospect, but the others would be dry. If a deferral option removed two of the five prospects, we would not subtract 200 million barrels from the total but would lose 40% of the opportunity to discover the 500 million barrels.

The Opportunity Index is defined by outputs from geologic and economic assessment models based on currently available data. These models assume that leasing, exploration, and development are unrestricted by regulations or industry funding. In reality, access to untested tracts and exploration budgets are key determinants of the level of industry interest in an area. Oil prices and Government regulations also are key determinants. Low oil prices and overly restrictive regulations could lessen industry interest in an area despite its high geologic potential. Future oil prices are difficult to foresee, and future corporate strategies for leasing are impossible to accurately predict. We can base our analysis of resource potential only on past leasing trends and petroleum assessments using current data. Each company may have a very different perspective of the development potential of an area such as Cook Inlet, an area of mature operations in State waters and recent interest in Federal waters. The key concept is that industry will only bid on tracts that they believe have some chance of becoming viable oil fields.

Notwithstanding the value of the Opportunity Index in understanding how to think about the likelihood of finding oil and gas resources, we caution the reader to exercise care in drawing conclusions about the Opportunity Index. The reader needs to keep the full context of the above paragraphs in mind when considering the Opportunity Index figures cited for the alternatives that follow.

II.B. ALTERNATIVE I – PROPOSED ACTION FOR SALES 191 AND 199

In this section, we describe (1) the two-sale structure, (2) the timing of activities, and (3) the activities associated with the Proposal. For additional information on resources and development activities, see Appendix B and Section IV.A.1 of this EIS. Section IV.B.1 provides an analysis of effects by resource category for each of the sales. Table II.B-2, column 2, provides a summary of the effects for this Alternative.

II.B.1. Two-Sale Structure

Alternative I - Proposed Action for Sales 191 and 199 offers for lease the entire area outlined on Figure I.A-1. As indicated by Table 1.A-1, this Alternative encompasses 517 whole or partial blocks covering 2.5 million acres (about 1.01 million hectares) in Cook Inlet. This area, minus leased blocks, would be offered in each of the two sales. The MMS assumes that exploration will follow each of the sales, but only a single field will be developed, producing approximately 140 million barrels of crude oil and 190 billion cubic feet of natural gas. Discovery of the field may result from exploration activities of either or both sales. A separate decision will be made on holding each sale. The decision for Sale 191 will be made in 2004, and the decision for Sale 2006 will be made in 2006.

II.B.2. Timing of Activities

A number of combinations of exploration and delineation wells allocated between the two sales could result in the discovery and development of the single field. This scenario presents one of the plausible or hypothetical combinations. Others are possible, but difference between scenarios in timing and location would be minimal.

The hypothetical scenario outlines how the drilling of two exploration wells and three delineation wells could lead to a single discovery that results in an economically producible field. The discovery could result from activity undertaken as the result of the first sale, the second sale, or from a combination of both sales (for example, if the field underlies two adjacent tracts, each leased in separate sales).

For the combination we selected, Table II.B-1 indicates the level of activity and the timing of events that follow the sales in 2004 and 2006 using an average drilling season, which potentially could be year-round in the lower Cook Inlet. However, unusually heavy winter ice, storms, and various environmental regulations could affect this schedule.

In the hypothetical scenario, an exploratory drilling rig would arrive in Cook Inlet in 2006 and remain through the completion of the drilling of four exploration (two from each lease sale) and three delineation wells, which concludes in 2010. Initially, the first exploration well would be drilled in 2006 on a tract leased in the first lease sale. Another exploration well would be drilled the following year on a tract leased in the second sale. One of these two wells would lead to a discovery. In 2007 and 2008, the exploratory rig would stay on the tract and drill one and two delineation wells, respectively, to define the extent of the field. In 2009, the rig would relocate to another tract leased in the first sale elsewhere in the sale area and drill another exploration well. The following year, the rig would move to drill the fourth and last exploration well in the sale area on a tract leased in the second lease sale.

The design and construction of the production platform would take place over a 3-year period ending with emplacement of the platform on site in 2011. Site surveys and permitting activities for the offshore pipeline would take place in the same time period, and laying the 25-mile, platform-to-shore oil pipeline would begin and conclude in 2010. Drilling of the 54 oil production and service wells would begin in 2011 and continues through 2014. Oil and gas production would commence in 2011. Natural gas not used for platform operation would be reinjected to maximize oil recovery and later recovered for gas sales. Laying of the 25-mile, platform-to-shore gas pipeline would begin and concludes in 2022, with sales gas being sent to shore that same year. Drilling an additional six gas-production wells would take place in 2023 and 2024. Oil production would cease in 2025, and gas production would cease in 2033. A 2-year decommissioning would begin that year.

II.B.3. Activities Associated with Exploration and Production

As previously noted, we estimate that exploration would result from each sale, and the exploration would result in a single discovery. Thus, the hypothetical scenario calls for two exploration wells to be drilled on tracts leased in Sale 191 and two exploration wells to be drilled on tracts leased in Sale 199. From these wells, a single discovery would result. Three delineation wells define the boundaries of the field. Development and production activities then commence. Table II.B-1 summarizes the activities for exploration and production that result from the lease sales.

II.B.3.a. Activities Associated with Exploration Drilling

Activities associated with exploration and production include seismic profiling (geophysical surveys), exploratory drilling, and delineation drilling, as described in the following.

II.B.3.a(1) Seismic-Profiling Activity

In support of the exploration activities, the lessee/operator may be required to conduct shallow hazards geophysical surveys. The MMS Alaska OCS Region's Notice to Lessee (NTL) 00-A01 - Shallow Hazards Geophysical Survey and Evaluation for OCS Exploration and Development Drilling outlines the requirements for the surveys. The projected level of seismic-profiling activity derives from the requirements listed in the NTL and the predicted number of wells. Surveys of the exploration- and delineation-well sites would be conducted during the late summer and early fall seasons to minimize conflicts with other users of Cook Inlet and to allow surveys to take place during the ice-free period.

Site-specific surveys cover each of the seven exploration and delineation wells. Each survey covers an approximate area of 9 square miles for each well; the total area covered by shallow hazards surveys equals 63 square miles. These surveys usually are conducted 1 year prior to drilling. (NTL 00-A01 allows some flexibility for modifying or waiving the specific shallow hazards requirements in areas where data of adequate coverage and quality are available.)

II.B.3.a(2) Exploration and Delineation Drilling

Exploration-well and delineation-well drilling could take place from a semisubmersible, jackup, or other type of bottom-founded unit. Water depth will be a significant factor in selecting the appropriate drilling unit. In the southern portion of the Cook Inlet OCS, most depths within the sale area range between 250 and 300 feet. Exploratory drilling throughout much of this area could be carried out by semisubmersible drilling units. In shallower waters, less than 200 feet deep, jackup rigs could be used. In the shallower portions of Cook Inlet, larger jackup rigs could remain onsite throughout the winter or spend the season in an ice-free port such as Kachemak Bay. In water less than 100 feet deep, a bottom-founded platform could be used.

We estimate exploration- and delineation-well-drilling depths to be an average of 6,000 feet. Drilling of each exploratory or delineation well would generate about 150 dry tons of drilling muds and approximately 440 dry tons of drill cuttings for disposal. In total, the seven wells would generate 1,050 tons of muds and 3,080 tons of cuttings. The Environmental Protection Agency's National Pollutant Discharge Elimination System permit for Cook Inlet exploration wells allows disposal of these materials by discharge into the marine environment (Rathbun, 1986; Clean Water Act of 1977, as amended [33 United States Code [U.S.C.] 1251 et seq]).

II.B.3.a(3) Support and Logistics Activities

Marine support for exploration in the Cook Inlet primarily stages from Nikiski. The network of oil-field-service contractors in the Kenai/Nikiski area aids logistic support. During the exploratory period, support and supply vessels would visit the drill platform every 1-2 days (or as needed). Any tugs required to assist the drilling unit move to other prospects or for emergency purposes remain on station near the drilling unit.

Air support for offshore drilling in the lower Cook Inlet is expected to come from the Kenai/Nikiski area, probably from the municipal airport; air support also might come from a helipad operated by an oil-field contractor. Offshore workers, mail, drill cores, and various perishable and lightweight priority items would be transported to the site by helicopter. Helicopter trips per day will vary, averaging between one and two a day.

Drilling-unit crews primarily would be workers from outside the communities adjacent to the sale area. However, given the Kenai Peninsula's history of involvement with oil and gas development, some exploration workers well may be residents of the Kenai Peninsula. In general, workers travel to and from the sale area by jet or turboprop aircraft using the airport at Kenai. These crews transfer to site by helicopter.

II.B.3.b. Activities Associated with Development and Production

Work on offshore and onshore production and transportation facilities begins after completion of the engineering and economic assessments of the prospect and after the field operator obtains the necessary permits.

II.B.3.b(1) Seismic-Profiling Activity

In support of the production platform installation and pipeline placement, the lessee/operator may be required to conduct shallow hazards geophysical surveys. The MMS Alaska OCS Region's NTL's 00-A01 and 00-A02 outline the requirements for the surveys for production platforms and pipeline routes, respectively. (The two NTL's allow some flexibility for modifying or waiving the specific shallow hazards requirements in areas where data of adequate coverage and quality are available.)

The projected level of seismic profiling derives from the requirements listed in the two NTL's. Surveys would be conducted during the late summer and early fall seasons to minimize conflicts with other users of Cook Inlet and to allow surveys to take place during the ice-free period. The average time needed to survey the production platform site and pipeline route should range between 2 and 5 days each.

We estimate the survey for the platform site to cover approximately 9 square miles and 11 square miles for the survey for the pipeline route, with a total track-line distance of approximately 125 miles. Surveys usually are conducted 1 year prior to platform emplacement.

II.B.3.b(2) Production Infrastructure

A steel-jacket, bottom-founded drilling platform, either with legs or a monotower, engineered for ice resistance, and similar to those already in place in upper Cook Inlet, could be used to develop the field. Construction and outfitting of the platform would take place in an ice-free harbor of the North Pacific. The platform would be towed to the site and installed during an ice-free period. A purpose-built platform could be towed into the area to serve as both exploration and (if successful) production platform, similar to the strategy recently used in Cook Inlet at the Forest Oil's Redoubt Shoal prospect, with a rig built in Korea with locally fabricated production modules.

As shown in Table II.B-1, the 25-mile long platform-to-shore oil pipeline, with landfall estimated to be north of Anchor Point, will be completed in 2010. The subsea pipeline system probably would not have to be trenched; however, designs would consider the strong tidal currents present in the Cook Inlet.

For our hypothetical scenario, production platform installation would take place in 2011. Drilling of development and injection wells could begin after the platform is set and as the topside module installation continues. Production would start in 2011 and peak by 2014. Oil production would cease in 2025.

Platform operation would consume approximately 0.5 billion cubic feet of natural gas production each year, and the rest would be reinjected. A 25-mile long platform-to-shore gas pipeline would be installed in 2022. Starting that year, sales gas would be sent to shore through the pipeline. Sales-gas production would cease and decommissioning would start in 2033.

The target depth for production wells is estimated at 7,500 feet. A total of 60 production and injection wells would be drilled: 54 production and service wells from 2011-2014 and 6 additional production wells drilled in 2023 and 2024. Production- and service-well drilling requires approximately 75 dry tons of drilling mud and generates 550 dry tons of rock cuttings per well. Some of the muds used in drilling production and service wells may be recycled through each subsequent well. However, as explained in Appendix B, the scenario assumes that produced water, drilling fluid wastes, muds, and cutting would be reinjected rather than discharged into the marine environment. (For a comparison of effects, the Sale 149 EIS discussed the effects of the discharge into the marine environment of drillings fluids, muds, and cuttings from production wells.)

II.B.3.b(3) Support and Logistics Activities

Air- and marine-support activities stage from the Kenai Peninsula. Support-vessel operations stage from Nikiski. Material storage and general logistics support would be facilitated by Kenai's existing oil-field-support infrastructure. This infrastructure, a network of private contractors, has developed over the last 40 years to serve onshore oil and gas production on the Kenai Peninsula and offshore production in the upper Cook Inlet. Air support for lower Cook Inlet drilling operations also comes from the Kenai/Nikiski area. A dedicated helipad at the Kenai airport could be used to transfer personnel to the drill site. Personnel arriving for transport to the drill site initially enter the Kenai area via commercial fixed-wing aircraft; however, early on in the developmental phase, offshore workers usually are or become local residents.

Support-boat and air operations average one to two trips per day (or as needed), with the frequency diminishing into the production period. Additional support vessels and helicopters would be kept on contract in proximity to drill operations to provide emergency assistance, if required.

II.B.3.b(4) Activities Associated with Oil and Gas Transportation

For our hypothetical scenario, two 25-mile long subsea pipelines would transport produced oil and gas to a landfall north of Anchor Point. Oil-pipeline construction takes place in 2010, and gas-pipeline construction takes place in 2022. The subsea oil and gas pipelines would not be buried. Due to the Cook Inlet's turbid conditions and the depth at which the pipeline would rest, the weighted pipe would become covered with silt or would be self buried. Within 2-3 miles of the tidelands, the pipeline would be buried to prevent damage from natural or human causes. All production will be used in the Cook Inlet area. As such, we foresee no tankering of Cook Inlet OCS production and that Cook Inlet OCS production will offset importation of petroleum by tanker from other sources, such as Trans-Alaskan Pipeline System crude oil.

Onshore, up to 75 miles of oil pipeline may need to be constructed from the landfall north of Anchor Point to the Nikiski oil and gas complex either in existent or anticipated pipeline corridors near the Sterling Highway. While an exact route cannot be established, the pipeline route would have to comply with the following Alaska Coastal Management Plan policies, as outlined in Sections IV.B.1.s(3)(d) and IV.B.1.s(3)(e). The landfall would avoid sensitive aquatic habitat. The route for the pipeline would be sited inland from shorelines and beaches, and pipeline crossings of anadromous fish streams would be minimized and consolidated with other utility and road crossings of such streams. Pipelines would be buried wherever possible and sited in existing rights-of-way for other utilities or transportation systems wherever possible, such as that provided by the Sterling Highway. The pipelines would not interfere with the migration of wildlife and would be designed, constructed, and maintained to minimize risk to fish and wildlife habitats from a spill, pipeline break, or other construction activity.

Pipe delivery could generate between 450 and 600 one-way truck trips on the Sterling Highway, approximately 2-3 round trips daily. Heavy construction equipment movement and workers commuting to and from the construction site would add an unknown number of trips per day. For the year 2000, the State of Alaska estimated that monthly average daily traffic in and around the Anchor Point area averaged 4,500 vehicles during the peak summer months and declined to about 1,000 during the winter months, of which an estimated 750 and 150, respectively, were trucks.

II.B.4. Summary of Effects by Sale

In this section, we summarize the effects by category of holding the two sales, should the Secretary decide to hold Sale 191 in 2004 and Sale 199 in 2006. Table II.B-2 presents a summary of effects by resource. For purposes of analysis, the MMS assumes that a single field containing 140 million barrels of oil and 190 billion cubic feet of natural gas could be discovered and produced for each sale. Only a small percentage of the blocks available for lease under the Proposed Action for Sales 191 and 199 likely would actually be leased. Of the blocks that might be leased, only a portion would be drilled; of these, only a very small portion, if any, likely would result in production.

If either or both of the lease sales are held and result in exploration or development, or both, routine industrial activities associated with oil and gas exploration and development would generate some degree of disturbance, noise, and discharges into the environment. This EIS analysis finds that no significant effects are anticipated from routine permitted activities. Significance thresholds are defined in Section IV.A.1. Although small oil spills and some small gas releases are accidental in nature, they are expected to occur should exploration, development, and production take place; therefore, we include the effects of small spills and small gas releases to the environment in the routine operations part of the analysis.

We do not expect other accidents or unplanned activities, primarily large oil spills equal to or greater than 1,000 barrels, or large natural gas releases to occur. There is a 19% probability of a large oil spill equal to or greater than 1,000 barrels for the single field discovered and developed in the hypothetical scenario used to analyze the effects of the sales. For purposes of analysis, we examine the effects of one large spill of either 1,500 barrels (platform spill) or 4,600 barrels (pipeline spill). The low probability makes it highly unlikely that a large oil spill would occur and contact these resources. Similarly, for analytical purposes, we assume a blowout of a single well on the platform releasing 10 million cubic feet of natural gas for 1 day, and that the gas ignites and burns until the gas flow ceases.

The analysis revealed no significant impacts to resources from routine operations associated with exploration, development, and production. The analysis identified potentially significant effects from an unlikely large oil spill to essential fish habitat, endangered and threatened species, commercial fisheries, sport fisheries, recreation and tourism, archaeological sites, and national parks. The realization of these impacts depends not only on the oil spill occurring but on closure of the commercial fishery or contact by the oil in areas where sport fishing, recreation and tourism, and archaeology resources occur.

While effects to estuarine and marine essential fish habitat generally would be low because fish habitat would be expected to recover within a month or so, effects on beach and intertidal fish habitats could be considered significant because oil could remain in these areas or prey could be impacted for more than a decade. For endangered species, sea otters from the southwest Alaska stock and Steller sea lions (particularly from the western population) could experience significant effects from an unlikely large oil spill. However, while the vulnerability of sea otters to oil spills is clear, the level of vulnerability to Steller sea lions is less certain. Commercial fisheries in Cook Inlet and possibly Kodiak Island/Shelikof Strait could be significantly affected depending on time, size, and location of the spill. For example, if a 4,600-barrel spill in the spring caused closure of the fishery, the loss could be in excess of 22% of average annual value of the commercial fishery. Sport fisheries could be similarly affected, with a loss in excess of 20%. If the spill contacted the clam and other shellfish-gathering areas within Cook Inlet, significant effects could result with the decline in the population of intertidal organisms for 1 year with oil in shoreline sediments for up to 10 years. Locally significant effects could occur to coastal-dependent and coastal-enhanced recreation and tourism areas contacted by the spill if it occurs during the high-use season (May to September) and results in loss of access to recreation resources. Oil contamination and spill-cleanup activities from the unlikely spill could disturb significant archaeological resources. If a spill occurs, either the coastlines of Katmai or Lake Clark National Park could be affected. Actual effects on the intrinsic and visual values of the park's coastline would last for less than 3 years. This would be a significant effect. However, public perception of damage could last for a greater time.

Table II.B-2 summarizes the effects by resources and alternative for Sales 191 and 199. The summaries of the effects apply to each individual sale and for all of the deferral alternatives for each sale. The two deferral alternatives provide various degrees of protection to the resources in or near those specific areas for each sale; however, none of the deferral alternatives changes the level of significant impacts identified for any of the proposed sales. For both sales, we estimate about twice the exploration activities as for one sale. The types of effects would be essentially the same but would occur at different locations. Also, whether either or both sales are held, we estimate only one development. Therefore, our analysis concluded that for most resources the effects would be essentially the same whether either or both lease sales are held. This is primarily because all of the alternatives for the sales assume that essentially the same amount of oil (140 million barrels) and gas (190 billion cubic feet) would be developed, even though the opportunity to find that volume of oil changes slightly with the selection of one or more alternatives. The economics of developing an oil field in the Cook Inlet requires that certain minimum quantities of oil be discovered; otherwise, development will not occur. The amount of oil the MMS assumes in the EIS for the alternatives in each of the two sales does not vary. In addition, many of the key biological resources migrate in and out of the Cook Inlet area, and many of the key species use large areas of the Cook Inlet area when they are present.

The activity in each sale is the same, with leasing, exploration, and development of a single field occurring from operations that result from either or both sales. Essentially, the scenario calls for two exploration wells to be drilled as the result of each lease sale. A single rig will drill all wells. From this exploration, a single field will be discovered and developed. Therefore, the effects to each of the resources from both of these sales are very similar.

II.C. ALTERNATIVE II – NO LEASE SALE

Under Alternative II-No Lease Sale, we could choose not to hold one or both of the proposed sales in the Cook Inlet Planning Area. If neither sale is held, none of the potential 140 million barrels of oil or 190 billion cubic feet of natural gas would be produced, and none of the environmental effects that would result from proposed oil development associated with each sale would occur in the Cook Inlet area. No potential oil spills and no effects to the physical, biological, or human environment from development from this sale would occur along in Cook Inlet. The economic benefits, royalties, and taxes to the Federal and State Governments would be forgone. If only one sale is held, the effects would be essentially the same as for Alternative I because, as explained in Section II.B.4 above, the difference in the hypothetical scenario between Sale 191 and Sale 199 is the drilling of two exploration wells.

If neither lease sale is held, different effects could result. Cook Inlet still would be exposed to ongoing oil and gas and other activities in the area. In fact, because most of the oil and gas production from Cook Inlet will be consumed by communities in the Cook Inlet area, the potential production can be offset by only a combination of future development and imports from other areas. Reliable and predictable local resources enhance opportunities for sustainable community development. Communities around Cook Inlet would not realize beneficial economic effects. For example, because the pipeline would not be installed, the Kenai Peninsula Borough would not realize about $2.7 million per year in property tax revenue for 15 years, and the jobs that are important to the continued economic and social well being of the community would not be created. Natural gas supplies needed to offset declining local production in the face of increasing demand would not be developed.

Nationally, to replace the oil and natural gas not developed from the sales in the Cook Inlet multiple-sale program, a large portion of the oil likely would be imported from other countries. Other substitutes (for example, nonpetroleum fuels, solar, nuclear, and conservation) could replace a small part of the lost production. The mix of imported oil and other substitutes is assumed to be market driven. See Section IV.B of this EIS, and Sections 2.5 and 4.7 (pp. 2-36 to 2-37 and 4-187 to 4-202) of the OCS Oil and Gas Leasing Program: 2002-2007 Final EIS (USDOI, MMS, 2002), which is incorporated by reference. That analysis estimates that nationwide, imports would replace 86-88% of the lost oil. Conservation would replace about 6-7%, and increased use of natural gas would replace about 4-5% of the lost oil production. Increased onshore oil production is estimated to offset about 3% of lost offshore production. Because of the projected high level of imports, the associated environmental impacts from producing oil and transporting that oil to market still would occur but in a different location, and they probably would be of a different magnitude. Imported oil imposes negative environmental effects in producing countries and in countries along the trade routes. By not producing our own domestic oil and gas resources in Cook Inlet and elsewhere around the United States, we are instead relying on imported oil. From a global perspective, by importing oil, we are in fact exporting at least a sizeable portion of the environmental impacts associated with oil we consume to other countries where the oil is produced and to those countries along the tanker routes. Also, these imports have attendant negative effects on the Nation's balance of trade (see Section IV.B.2).

II.D. ALTERNATIVE III — LOWER KENAI PENINSULA DEFERRAL

MMS developed Alternative III, the Lower Kenai Peninsula Deferral , based on analysis of areas offered for leasing in our previous Cook Inlet lease sale, Sale 149 (for example, the Kennedy Entrance deferral), location of critical habitat for the endangered Steller sea lion, and in response to comments received during scoping. In part, this deferral was developed as a potential way to reduce conflicts between subsistence users and offshore oil and gas operations and was based on input from the Native Village of Port Graham and others and analysis of subsistence resource-use patterns. Other comments received during scoping addressed the compatibility of offshore oil and gas activity with recreation, tourism, and visual resources in the Kachemak Bay and lower Cook Inlet area. As shown in Figure I.A-1 and Table I.A-1, this alternative would offer for leasing all of the area described for Alternative I except for a subarea located in the eastern portion of the proposed sale area offshore of Homer, Seldovia, Port Graham, and Nanwelek. Alternative III would offer 483 whole or partial blocks, comprising 2,337,000 acres (about 945,770 hectares). The areas that would be removed by the Lower Kenai Peninsula Deferral consist of 34 whole or partial blocks, approximately 163,100 acres, which is about 6.5% of the Alternative I area.

Section IV.B.3 of this EIS analyzes whether increased protection would be provided by this alternative to subsistence activities and wildlife from disturbance caused by exploration or development and production activities. The analysis concluded that the deferral would reduce potential impacts to endangered and threatened species including beluga whales, Steller sea lions, sea otters, and humpback whales; reduce impacts to marine and coastal birds; reduce visual impacts by moving the potential platform locations farther offshore; and protect historic archaeological resources that may be present in the deferral area. The analysis concludes that for most resources, although the alternative would provide a measure of protection to the resources within the deferral area, the effects to the resources in the Cook Inlet area under this alternative would be essentially the same as the effects under Alternative I. See Table II.B-2, column 3, for a summary of the effects from this alternative. Although the selection of this alternative slightly decreases the opportunity of discovering a commercial field, the resources in this area still could be affected by an unlikely large oil spill that occurred elsewhere in the sale area.

II.E. ALTERNATIVE IV – BARREN ISLANDS DEFERRAL

MMS developed Alternative IV, Barren Islands Deferral, based on analysis of areas offered for leasing in our previous Cook Inlet lease sale, Sale 149 (for example, the Kennedy Entrance deferral); location of critical habitat for the endangered Steller sea lion; and in response to comments received during scoping. In part, this deferral was developed as a potential way to reduce conflicts between subsistence users and offshore oil and gas operations and was based on input from the Native Village of Port Graham, Nanwalek, and Seldovia and others and analysis of subsistence resource-use patterns. Other comments received during scoping addressed operating conditions in the Kennedy Entrance between the Barren Islands and the lower Kenai Peninsula. As shown in Figure I.A-1 and Table I.A-1, this alternative would offer for leasing all of the area described for Alternative I except for a subarea located off of the Barren Islands. Alternative IV would offer 481 whole or partial blocks, comprising 2,342,000 acres (about 947,794 hectares). The areas that would be removed by the Barren Islands Deferral consist of 36 whole or partial blocks, approximately 158,000 acres, which is about 6.32% of the Alternative I area.

Section IV.B.4 of this EIS analyzes whether increased protection would be provided by this alternative to subsistence activities and wildlife from disturbance caused by exploration or development and production activities. The analysis concluded that the deferral would reduce potential impacts to endangered and threatened species, including beluga whales, Steller sea lions, sea otters, and humpback and other whales, would reduce effects to marine and coastal birds, and would reduce visual impacts by moving the potential platform locations farther offshore. The analysis concludes that for most resources, although the alternative would provide a measure of protection to the resources within the deferral area, the effects to the resources in the Cook Inlet area under this alternative would be essentially the same as the effects under Alternative I. Table II.B-2, column 4, summarizes the effect of this alternative. Although the selection of this alternative slightly decreases the opportunity of discovering a commercial field, the resources in this area still could be affected by an unlikely large oil spill that occurred elsewhere in the sale area.

II.F. MITIGATING MEASURES

Laws and regulations that provide mitigation are considered part of the Proposed Action (Alternative I) and Alternatives III and IV for Sales 191 and 199. Examples include the OCS Lands Act, which grants broad authority to the Secretary of the Interior to control lease operations and, where appropriate, undertake environmental monitoring studies; the MMS Offshore Operating Regulations (30 Code of Federal Regulations [CFR] 250, et seq.); and the Fishermen's Contingency Fund.

Most of the following mitigating measures (Stipulations and ITL clauses) also are considered standard mitigating measures, because they have been selected in past OCS lease sales. Standard stipulations (Section II.F.1) and ITL clauses (Section II.F.2) are evaluated and factored into the effects analysis as part of the Proposed Action and alternatives. The environmental effects analyses in Section IV.B.1 discuss the effectiveness of the stipulations described in this section where appropriate to a given resource. A summary of the overall effectiveness of each stipulation is provided in the following section, immediately after the text of the stipulation. No other mitigating measures were developed for this EIS. Some of the stipulations included in this analysis as assumed mitigating measures from past OCS oil and gas lease sales in Cook Inlet, such as Protection of Fisheries, have been reworded to bring them up-to-date with current information and situations.

The ITL clauses also have been somewhat revised from past sales. Some ITL clauses, such as ITL No. 5 - Oil-Spill-Response Preparedness, have been revised because they have been incorporated into the MMS operating regulations. The ITL No. 6 - Drilling Fluid Cuttings and Discharge during Post-Lease Activities was evaluated as a standard stipulation in the Cook Inlet Sale 149 EIS and was considered for inclusion as a stipulation for Sales 191 and 199. Further review and analysis revealed that the ITL clause was the more appropriate format for the measure. The ITL clause informs prospective lessees of the regulatory authority that govern Environmental Protection Agency and MMS actions regarding discharges during postlease activities.

II.F.1. Standard Stipulations

The following standard stipulations are considered part of the Proposed Action and Alternatives III and IV:

- No. 1 – Protection of Fisheries
- No. 2 – Protection of Biological Resources
- No. 3 – Orientation Program
- No. 4 – Transportation of Hydrocarbons

Following is the language of the stipulations and a summer of the effectiveness of each stipulation.

II.F.1.a. Stipulation No. 1 – Protection of Fisheries

Exploration and development and production operations shall be conducted in a manner that avoids unreasonable conflicts with the fishing community and their gear (including, but not limited to, subsistence and sport- and commercial-fishing activities).

Prior to submitting an Exploration Plan (EP) or Development and Production Plan (DPP), as required by 30 CFR 250.203 (b) 14 and 17, and 250.204 (b)(8)(C)(v)(g) and (9), the lessee shall review planned exploration and development activities, including

- plans for seismic surveys;
- drill rig transportation;
- mobilization, scheduling, and location of drilling unit and crew and supply boat routes; and
- other vessel traffic;

with directly affected fishing organizations, subsistence communities, and port authorities to avoid unreasonable fishing gear conflicts.

The EP or DPP shall include a summary of fishing activities in the area of proposed operation, an assessment of effects on fishing from the proposed activity, and measures taken by the lessee to prevent unreasonable conflicts. This summary shall provide a method for identifying and publicizing the exploration and development activities to avoid possible conflicts.

Local communities, including fishing interests, will have the opportunity to review and comment on proposed EP's and DPP's as part of the Minerals Management Service (MMS) regulatory review process pursuant to 30 CFR 250.203 and .204. The comments will be considered during MMS's decision to approve, disapprove, or require modification of the plan.

Lease-related use can be restricted if the Regional Supervisor, Field Operations (RSFO), determines that the lessee proposed measures will not prevent unreasonable conflicts. The RSFO will work with directly affected parties to assure that potential conflicts are identified and efforts are taken to avoid these conflicts. These efforts could include timing operations to avoid fishing activities, such as drift net fisheries that generally take place north of Anchor Point between June 25 and August 5, or locating structures away from major rip currents where fishing activities may be denser. In order to avoid these conflicts, restrictions, including directional drilling, seasonal drilling, subsea completion techniques and other technologies deemed appropriate by the RSFO, may be required.

Summary of the Effectiveness of Stipulation No. 1. The conflict addressed in this stipulation primarily is spatial; therefore, the purpose of this stipulation is to ensure that the petroleum industry and the participants in subsistence-, sport-, and commercial-fishing activities have a mechanism to ensure their activities are coordinated to minimize conflicts. Much of the Cook Inlet region has intensive commercial fishing for shellfish, groundfish, herring, and salmon during almost all periods of the year although, for the most part, these commercial fisheries do not operate concurrently. Some seasons, such as that for herring, are very short. The fishing areas also are widespread from shoreline to far offshore. While widely distributed, some areas within this distribution have concentrated vessels and gear. This stipulation evolved from space use issues and concerns raised during the Sale 149 process. The stipulation was developed, in part, as a way of addressing specific characteristics of the variety of commercial that occurs in the Cook Inlet. Even though space use conflict was not identified as a major issue during scoping for Sales 191 and 199, this stipulation will be effective in addressing potential conflicts. In doing so, this stipulation also addresses the conflict with commercial-fishing concerns raised in the Tri-Borough Agreement.

In addition, subsistence fishing also occurs throughout Cook Inlet. Most of the households in the communities of Port Graham and Nanwalek participate in subsistence harvests. These communities, along with Tyonek, have substantial subsistence harvests that include salmon, halibut, crab, and clams. This issue was raised during scoping for Sales 191 and 199. Sport fishing occurs throughout the sale area and in adjacent waters. This fishery includes fishing for salmon and halibut from both charter and private vessels, fishing from the shore, and harvesting of shellfish such as clams and crabs.

Without safeguards, subsistence, sport, and commercial fishing may be subject to interference from offshore oil and gas operations.

This stipulation helps to ensure early planning by the petroleum industry to prevent or reduce potential conflicts with subsistence, sport, and commercial fishing. This stipulation provides additional protection by advising lessees that exploration, development, and production activities should be conducted in a manner that minimizes any potential conflicts between the oil and gas industry and fishing activities. This measure will be especially useful in preventing interference with subsistence, sport, and commercial fishing from seismic surveys that could cause gear damage to or loss of fixed fishing gear. In addition, other users of the OCS, such as kayakers and tour-boat operators, may find the information regarding vessel traffic useful in planning their activities. The stipulation enhances Environmental Justice by reducing potential effects to minority and low-income populations involved in subsistence and commercial fishing.

II.F.1.b. Stipulation No. 2 – Protection of Biological Resources

If biological populations or habitats that may require additional protection are identified in the lease area by the Regional Supervisor, Field Operations (RSFO), the RSFO may require the lessee to conduct biological surveys to determine the extent and composition of such biological populations or habitats. The RSFO shall give written notification to the lessee of the RSFO's decision to require such surveys.

Based on any surveys that the RSFO may require of the lessee or on other information available to the RSFO on special biological resources, the RSFO may require the lessee to:

- Relocate the site of operations;
- Establish to the satisfaction of the RSFO, on the basis of a site-specific survey, either that such operations will not have a significant adverse effect upon the resource identified or that a special biological resource does not exist;
- Operate during those periods of time, as established by the RSFO, that do not adversely affect the biological resources; and/or
- Modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected.

If any area of biological significance should be discovered during the conduct of any operations on the lease, the lessee shall immediately report such findings to the RSFO and make every reasonable effort to preserve and protect the biological resource from damage until the RSFO has given the lessee direction with respect to its protection.

The lessee shall submit all data obtained in the course of biological surveys to the RSFO with the locational information for drilling or other activity. The lessee may take no action that might affect the biological populations or habitats surveyed until the RSFO provides written directions to the lessee with regard to permissible actions.

Summary of the Effectiveness of Stipulation No. 2. The level of protection provided by this measure will depend on several factors:

- the size of the population that might be subjected to adverse impacts and the number of individuals within the population that would be afforded protection by this stipulation;
- the overall size of habitat used by the resource of concern, and the portion of that habitat that may be affected by offshore oil and gas operations; and
- the uniqueness of the population or habitat.

Thus, the effectiveness of the stipulation could vary widely. If only a few members of a large population or a small amount of a large habitat area were to be affected by oil and gas operations, the mitigation provided by the stipulation would be minimal. However, if effects to many individuals of a small population or to most of the area of unique habitat are reduced or minimized because of this stipulation, then its effectiveness could be substantial. This stipulation lowers the potential adverse effects to unique biological communities that may be identified during oil and gas exploration or development activities and provided additional protection. It also would provide protection to fish (including the fish migration) from potential disturbance associated with oil and gas exploration and with development and production. To the extent that this stipulation protects previously unknown biological resources that may be used in subsistence harvest, the stipulation enhances Environmental Justice. This stipulation does not change the level of significant impacts that may occur from an unlikely large oil spill.

II.F.1.c. Stipulation No. 3 – Orientation Program

The lessee shall include in any exploration or development and production plans submitted under 30 CFR 250.203 and 250.204, a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) for review and approval by the Regional Supervisor, Field Operations. The program shall be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns that relate to the area that could be affected by the operation or its employees. The program shall address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and provide guidance on how to avoid disturbance. The program shall be designed to increase the sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which such personnel will be operating. The orientation program also shall include information concerning avoidance of conflicts with subsistence-, sport-, and commercial-fishing activities.

The program shall be attended at least once a year by all personnel involved in onsite exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors, and subcontractors.

The lessee shall maintain a record of all personnel who attend the program onsite for so long as the site is active, not to exceed 3 years. This record shall include the name and date(s) of attendance of each attendee.

Summary of the Effectiveness of Stipulation No. 3. This stipulation provides positive mitigating effects by requiring all personnel involved in petroleum activities in Cook Inlet resulting from any leases issued from any of the two sales by providing awareness of the unique environmental, social, and cultural values of the local Native Alaskan residents and their environment. This stipulation should help avoid damage or destruction of environmental, cultural, and archaeological resources through awareness and understanding of historical and cultural values. It also would help minimize potential conflicts between subsistence-hunting and -gathering activities and oil and gas activities that may occur. However, the extent of reduction offered by this stipulation is difficult to measure directly or indirectly.

This stipulation provides protection to fish (including fish migration), marine and shorebirds, pinnipeds, beluga whales, and other species from potential disturbances associated with oil and gas exploration and with development and production by increasing the awareness of workers to their surrounding environment. Much of the information presented in the orientation program highlights information contained in the ITL clauses. The Orientation Program increases the sensitivity and understanding of workers to the values, customs, and lifestyles of Native communities and reduces the potential conflicts with subsistence resources and hunting activities. The stipulation enhances Environmental Justice by reducing potential effects to minority populations involved in subsistence fishing, and protecting important archaeological sites helps protect Native Alaskan culture. This stipulation does not change or lower the level of significant impacts that may occur from an unlikely large oil spill.

II.F.1.d. Stipulation No. 4 – Transportation of Hydrocarbons

Pipelines will be required: (a) if pipeline rights-of-way can be determined and obtained; (b) if laying such pipelines is technologically feasible and environmentally preferable; and (c) if, in the opinion of the lessor, pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts.

The lessor specifically reserves the right to require that any pipeline used for transporting production to shore be placed in certain designated management areas. In selecting the means of transportation, consideration will be given to recommendations of any advisory groups and Federal, State, and local governments and industry.

Following the development of sufficient pipeline capacity, no crude oil production will be transported by surface vessel from offshore production sites, except in the case of an emergency. Determinations as to emergency conditions and appropriate responses to these conditions will be made by the Regional Supervisor, Field Operations.

Summary of the Effectiveness of Stipulation No. 4. This stipulation reflects the agency preference for transporting offshore oil and gas in pipelines. This stipulation is consistent with the Tri-Borough Agreement. This stipulation helps reduce or moderate the potential effects to water quality, lower trophic-level organisms, fish and fish migration, endangered species, marine mammals, and other resources. In doing so, the stipulation enhances Environmental Justice by reducing potential effects to minority populations involved in subsistence fishing. However, it does not reduce the potential significant adverse effects from an unlikely large oil spill to any potentially affected resources to below significance threshold levels.

II.F.2. Standard Information to Lessees

The ITL clauses 1 through 6 are standard and apply to OCS activities in Cook Inlet. They are considered part of the Proposed Action and other alternatives for the Cook Inlet multiple-sale EIS for analysis purposes.

The following standard ITL clauses are considered part of the Proposed Action and Alternatives III and IV:

- ITL No. 1 – Bird and Marine Mammal Protection
- ITL No. 2 – Information on Endangered and Threatened Species
- ITL No. 3 – Sensitive Areas to be Considered in the Oil Spill Response Plans
- ITL No. 4 – Information on Coastal Zone Management
- ITL No. 5 – Oil-Spill-Response Preparedness
- ITL No. 6 – Drilling Fluids and Cuttings Discharge during Postlease Activities.

The effectiveness of the above ITL clauses varies. The primary purpose or focus of all of these ITL clauses is to provide the lessee with information about the requirements or mitigation required by other Federal and State agencies. The ITL clauses themselves provide no mitigation. However, the regulations and mitigation required by the other agencies are effective and do lower potential adverse impacts from proposed oil and gas activities. To the extent that the ITL clauses enlighten lessees and their contractors to these mitigation measures, the ITL clauses also may be considered effective.

Environmental Justice is enhanced by the ITL clauses. For example, the Port Graham/English Bay Area Meriting Special Attention was added to ITL No. 3 - Sensitive Areas to be Considered in Oil Spill Response Plans at the suggestion of Alaskan Natives during scoping because of the importance of the resources in this area to Native villages. The ITL clause also advises lessees that they have the primary responsibility for identifying these areas in their plans and for providing specific protective measures. Cook Inlet Spill Prevention and Response, Inc., funded by offshore oil and gas operators in the Cook Inlet, uses information on sensitive areas to develop geographic response strategies, including areas containing important subsistence resources.

II.F.2.a. ITL No. 1 - Bird and Marine Mammal Protection

The MMS advises lessees that during the conduct of all activities related to leases issued as a result of this sale, the lessee and its agents, contractors, and subcontractors will be subject to the following laws, among others: the provisions of the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 et seq.); the Endangered Species Act, as amended (16 U.S.C. 1531 et seq.); and applicable International Treaties.

Lessees and their contractors should be aware that disturbance of wildlife could be determined to constitute harm or harassment and, thereby, be in violation of existing laws and treaties. With respect to endangered species and marine mammals, disturbance could be determined to constitute a “taking” situation. Under the Endangered Species Act, the term “take” is defined to mean “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or to attempt to engage in such conduct.” Under the Marine Mammal Protection Act, “take” means “harass, hunt, capture, collect, or kill or attempt to harass, hunt, capture, or kill any marine mammal." Violations under these Acts and applicable Treaties may be reported to the National Marine Fisheries Service or the Fish and Wildlife Service, as appropriate.

Incidental taking of marine mammals and endangered and threatened species is allowed only when the statutory requirements of the Marine Mammal Protection Act, the Endangered Species Act, or both are met. Section 101(a)(5) of the Marine Mammal Protection Act allows for the taking of small numbers of marine mammals incidental to a specified activity within a specified geographical area. Section 7(b)(4) of the Endangered Species Act allows for the incidental taking of endangered and threatened species under certain circumstances. If a marine mammal species is listed as endangered or threatened under the Endangered Species Act, the requirements of both the Marine Mammal Protection Act and the Endangered Species Act must be met before the incidental take can be allowed.

Under the Marine Mammal Protection Act, the National Marine Fisheries Service is responsible for species of the order Cetacea (whales and dolphins) and the suborder Pinnipedia (seals and sea lions) except walrus; the Fish and Wildlife Service is responsible in Alaskan waters for polar bears, sea otters, and walrus. Procedural regulations implementing the provisions of the Marine Mammal Protection Act are found at 50 CFR Part 18.27 for the Fish and Wildlife Service and at 50 CFR Part 216 for the National Marine Fisheries Service.

Specific regulations must be applied for and in place and the Letters of Authorization must be obtained by those proposing the activity to allow the incidental take of marine mammals whether or not they are endangered or threatened. The regulatory process may require 1 year or longer.

Of particular concern is disturbance at major wildlife concentration areas, including bird colonies, marine mammal haulout and breeding areas, and wildlife refuges and parks. Lessees also are encouraged to confer with the Fish and Wildlife Service and the National Marine Fisheries Service in planning transportation routes between support bases and lease holdings.

Lessees should exercise particular caution when operating in the vicinity of species whose populations are known or thought to be declining and that are not protected under the Endangered Species Act: specifically, marbled murrelet, Pacific harbor seals, beluga whales, and northern fur seals.

Generally, behavioral disturbance of most birds and mammals found in or near the lease area would be unlikely if aircraft and vessels maintain at least a 1-mile horizontal distance and aircraft maintain at least a 1,500-foot vertical distance above known or observed wildlife concentration areas, such as bird colonies and marine mammal haulout and breeding areas. Specifically, the NMFS recommends that aircraft should maintain flight separation distances of 1,500 feet vertical and 0.5 miles horizontal over all Steller sea lion habitats and haulouts identified in 50 CFR 226.202.

For the protection of endangered whales and marine mammals throughout the lease area, it is recommended that all aircraft operators maintain a minimum 1,500-foot altitude when in transit between support bases and exploration sites. Lessees and their contractors are encouraged to minimize or reroute trips to and from the leasehold by aircraft and vessels when endangered whales are likely to be in the area.

Human safety should take precedence at all times over these recommendations.

II.F.2.b. ITL No. 2 - Information on Endangered and Threatened Species

The MMS advises lessees that the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) protects the following endangered or threatened species that may be in or adjacent to the area of the Proposed Action. Also, this ITL identifies candidate species for listing (those that may be proposed for listing or listed in the foreseeable future) in or near the area. The National Marine Fisheries Service manages and protects the marine mammals with the exception of the sea otter. The Fish and Wildlife Service manages and protects sea otters and avian species.

The National Marine Fisheries Service and the Fish and Wildlife Service will review exploration plans and development and production plans that you submit to the MMS to ensure the species listed below are protected. Please contact the National Marine Fisheries Service or Fish and Wildlife Service regarding proposed operations and actions that might be taken to minimize interaction with the species. In addition, Steller sea lion critical habitat exists in or adjacent to the area.

Common Name	**Scientific Name**	**Endangered Species Act Status**
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Northern Right whale (Eastern North Pacific Stock)	*Eubalaena japonica* aka *Eubalaena glacialis*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Steller sea lion (Western U.S. stock)	*Eumetopias jubatus*	Endangered
Steller sea lion (Eastern U.S. stock)	*Eumetopias jubatus*	Threatened
Beluga whale (Cook Inlet stock)	*Delphinapterus leucas*	Candidate
Short-tailed albatross	*Phoebastria albatrus* (formerly *Diomedea albatrus*)	Endangered
Steller's eider (Alaska breeding population)	*Polysticta stelleri*	Threatened
Northern Sea Otter (Southwest Alaskan stock)	*Enhydra lutris kenyonii*	Candidate

In addition, critical habitat for the Steller sea lion exists in the area; this habitat must also be protected. Please see 50 CFR § 226.202 for the area included in this critical habitat.

II.F.2.c. ITL No. 3 - Sensitive Areas to be Considered in the Oil-Spill-Response Plans

The MMS advises lessees that environmentally sensitive areas are valuable for their concentrations of marine birds, marine mammals, fishes, or other biological resources or cultural resources and should be considered when developing Oil-Spill-Response Plans. Identified areas of special biological and cultural sensitivity include:

- Critical habitat for the Steller sea lion listed in 50 CFR 226.202.
- Chisik and Duck Islands, Kamishak Bay, Kachemak Bay, the Barren Islands, Marmot Island, Tugidak Island, Chirikof Island, Puale Bay, and the Pye Islands all contain or are inhabited in whole or part by concentrations of biological resources that should be considered.
- In addition, five National Wildlife Refuges (Alaska Maritime, Alaska Peninsula, Becharof, Kenai, Kodiak); Lake Clark National Park and Preserve; Aniakchak National Monument and Preserve; Katmai National Park and Preserve; McNeil River State Game Sanctuary; State Game Refuges (Trading Bay and McNeil River); Critical Habitat Areas (Kalgin Island, Clam Gulch, Fox River Flats, Kachemak Bay Tugidak Island, and Redoubt Bay), Alaska State Parks (Shuyak, Afognak Island, Kachemak Bay, and Kachemak Bay Wilderness Park); and the Captain Cook State Recreation Area are located near or adjacent to the Cook Inlet Planning Area and also include important concentrations of biological resources which should be considered in developing the Oil-Spill-Response Plan. These areas are managed by the U.S. Fish and Wildlife Service, National Park Service, and State of Alaska, respectively.
- National Historic Landmarks (Yukon Island Main site near Homer) have been identified as sensitive and should also be considered.
- Areas Meriting Special Attention (AMSA): The Kenai Borough Coastal Management Plan has identified the following AMSA: Port Graham/English Bay Area.

Industry should consult with the Fish and Wildlife Service, the National Park Service, or State or Borough personnel to identify specific environmentally sensitive areas within national wildlife refuges, national park system units, or State special areas that should be considered when developing a project-specific Oil-Spill-Response Plan. In addition, lessees should be familiar with geographic response strategies (GRS) being produced by Federal, state, local and non-government entities under the Alaska Unified Plan for the Cook Inlet and Kodiak Subarea Contingency Plan.

These areas are among areas of special biological and cultural sensitivity to be considered in the oil spill response plan required by 30 CFR 254. Lessees are advised that they have the primary responsibility for identifying these areas in their plans and for providing specific protective measures. Additional areas of special biological and cultural sensitivity may be identified during review of exploration plans and development and production plans.

Consideration should be given in Oil-Spill-Response Plans as to whether use of dispersants is an appropriate tactic in the vicinity of an area of special biological and cultural sensitivity. Lessees are advised that prior approval must be obtained before dispersants are used.

II.F.2.d. ITL No. 4 - Information on Coastal Zone Management

The MMS advises lessees that under the Coastal Zone Management Act (16 U.S.C. 1451 et seq., Section 307), as amended, a State with an approved Coastal Zone Management (CZM) Plan reviews certain OCS activities to determine whether they will be conducted in a manner consistent with their approved CZM plan. This review authority is applicable to activities described in OCS exploration plans and development and production plans that affect any land or water use or natural resource within the State's coastal zone. Generally, the MMS may not issue a permit for activities described in a plan unless the State concurs or is conclusively presumed to have concurred that the plan is consistent with its CZM plan. In cases where concurrence is not given or presumed, the matter may be appealed to the Secretary of Commerce.

The Department of Commerce, National Oceanic and Atmospheric Administration, revised the regulations at 15 CFR 930 implementing the Federal consistency provisions of the Coastal Zone Management Act effective January 8, 2001. These revised regulations were published in the *Federal Register* on December 8, 2000, at 65 *FR* 77124, et seq.

The Alaska Coastal Management Plan includes Statewide standards found in 6 AAC 80 and enforceable policies found within approved coastal district programs. For the Cook Inlet OCS lease sales, the enforceable policies of the Kenai Peninsula, Kodiak Island, and Lake and Peninsula Boroughs Coastal Management Programs and the Statewide standards are applicable.

In accordance with the requirements of 15 CFR 930.76(c), the MMS Alaska OCS Region sends copies of exploration plans and development and production plans, including the consistency certification and other necessary information, to the State of Alaska, Division of Governmental Coordination. State agencies and coastal districts adjacent to the activity review these plans for consistency with their Coastal Management Programs.

II.F.2.e. ITL No. 5 - Information on Oil-Spill-Response Preparedness

The MMS advises lessees that they must be prepared to respond to oil spills which could occur as a result of offshore natural gas and oil exploration and development activities. With or prior to submitting a plan of exploration or a development and production plan, the lessee will submit for approval an Oil-Spill-Response Plan in accordance with 30 CFR 254. Of particular concern are sections of the Oil-Spill-Response Plan that address the following:

- potential spill size and trajectory,
- specific actions to be taken in the event of a spill,
- the location and appropriateness of oil-spill equipment, and
- the ability of the lessee to protect communities and important resources from adverse effects of a spill.

In addition, lessees will be required to conduct spill response drills that include deployment of equipment to demonstrate response preparedness for spills under realistic conditions.

II.F.2.f. ITL No. 6 - Drilling Fluids and Cuttings Discharge during Post-Lease Activities

The MMS advises lessees that the Environmental Protection Agency prohibits discharge of drilling fluids and cuttings into marine waters unless authorized by an approved National Pollutant Discharge Elimination System permit. For Cook Inlet, if feasible, the Environmental Protection Agency may require methods for disposing of drilling fluids and cuttings other than discharge into the marine environment. If discharge is authorized, you may be required by Environmental Protection Agency to monitor the fate and effects of the discharge on the marine environment.

The MMS lease sale Environmental Impact Statement provides a thorough description and analysis of water quality and biological resources in the area. MMS will work with the Environmental Protection Agency to examine the technically and economically feasible methods for disposal of drilling fluids and cuttings and their environmental effects during postlease activities.

By agreement between the Department of the Interior and the Environmental Protection Agency, the MMS may conduct National Pollutant Discharge Elimination System permit compliance inspections of postlease operations authorized under the Outer Continental Shelf Lands Act. Also, in accordance with 30 CFR 250.300 (b)(1), the MMS may restrict the rate of drilling fluid discharge or prescribe alternative discharge methods. The MMS may also restrict the use of components which could cause unreasonable degradation to the marine environment.

II.F.3. Other Information to Lessee Clauses Developed for Consideration in this EIS

The MMS decided it would be useful information to the public and future lessees to add the following optional ITL clause, No. 7 - Information on Air Quality Regulations and Standards. The ITL informs the lessee of the regulations in effect for the Cook Inlet area regarding the prevention of significant deterioration for air quality.

II.F.3.a. ITL No. 7 - Information on Air-Quality Regulations and Standards

Under the provisions of the Clean Air Act Amendments of 1990, the Environmental Protection Agency has jurisdiction for air quality over the Cook Inlet OCS program area. Lease operators must comply with the EPA's requirements for OCS sources, including the provisions of Title I, Part C, of the Clean Air Act (Prevention of Significant Deterioration of Air Quality). Section 328 of the Act states that for a source located within 25 miles of the seaward boundary of a State, requirements would be the same as those that would apply if the source were located in the corresponding onshore area.

Federal regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods. The standards include Prevention of Significant Deterioration (PSD) provisions for nitrogen dioxide, sulfur dioxide, and particulate matter less than 10 microns in diameter. The provisions limit deterioration of existing air quality that is better than that otherwise allowed by the standards (an attainment area). Maximum allowable increases in concentrations above a baseline level are specified for each PSD pollutant. PSD areas are ranked in three classes (I, II, and III). Class I, the most restrictive, which applies to certain national parks, monuments, and wilderness areas, allows the least degradation and restricts degradation of visibility.

Lessees are advised that a portion of the Alaska Maritime National Wildlife Refuge, the Tuxedni National Wilderness Area (designated by Public Law 91-504 which is composed of Chisik and Duck Islands), is the only Class I area adjacent to the Cook Inlet OCS program area.

Operators seeking an air quality permit for activities projected to result in emissions greater than 250 tons/year, need to submit a PSD analysis to EPA Region X. If the proposed activities are located within 100 kilometers of the Tuxedni PSD Class I area, the permit application is subject to review by the Fish and

Wildlife Service, which in consultation with the EPA, will determine if the proposed project will have an adverse impact on air quality related values, including visibility, in the area (see 40 CFR 51.166 (p) or 40 CFR 52.21 (p)). The operator should consult EPA Region X for guidance regarding the type of information that they require to be included in the permit application.

II.G. DESCRIPTION OF THE AGENCY-PREFERRED ALTERNATIVE

The NEPA Council on Environmental Quality regulations require that an agency-preferred alternative be identified in the final EIS. The MMS has reviewed the analysis of the alternatives in the EIS, comments received on the draft EIS, and other pertinent information and developed the MMS agency-preferred alternative. The MMS agency-preferred alternative is the combination of Alternative III - the Lower Kenai Deferral and Alternative IV - the Barren Islands Deferral, including all the following stipulations and Information to Lessee clauses:

Stipulation No. 1 – Protection of Fisheries
Stipulation No. 2 – Protection of Biological Resources
Stipulation No. 3 – Orientation Program
Stipulation No. 4 – Transportation of Hydrocarbons

ITL No. 1 – Bird and Marine Mammal Protection
ITL No. 2 – Information on Endangered and Threatened Species
ITL No. 3 – Sensitive Areas to be Considered in the Oil Spill Response Plans
ITL No. 4 – Information on Coastal Zone Management
ITL No. 5 – Oil-Spill-Response Preparedness
ITL No. 6 – Drilling Fluids and Cuttings Discharge during Post-Lease Activities
ITL No. 7 – Information on Air Quality Regulations and Standards

Using the hypothetical scenario outlined in Section II.B and Appendix B, Section IV.B.1 analyzes the effects on 19 different resource categories by alternative and by sale. Section IV.B.3 analyzes the effects when the Kenai Peninsula Deferral is considered, and Section IV.B.4 analyzes the effects when the Barren Islands Deferral is considered. Sections IV.C through IV.E are general topics common to all resources. Section IV.F analyzes the effects of a low-probability, very large oil spill. Section V discusses the cumulative effects, as defined by NEPA, on the same 19 resources. Section II.F describes the mitigating measures that are incorporated as part of this agency-preferred alternative (standard stipulations and their effectiveness), standard ITL clauses, and the optional ITL clause. (These stipulations and ITL's are included in all alternatives, including the agency-preferred alternative.) We do not provide a separate evaluation of the potential effects of the agency-preferred alternative, which is a combination of Alternative III and IV, because it would repeat the entire analysis done for Alternative III (Sections IV.B.3) and Alternative IV (Sections IV.B.4).

We have added the agency-preferred alternative information to Table I.A-1. For the agency-preferred alternative, Figure I.A-2 shows the area that would be offered for leasing and the area that would be deferred from Sale 191. Table II.B-3 summarizes the effects of the agency-preferred alternative from routine operations and an unlikely large oil spill and highlights the differences between the effects of the agency-preferred alternative compared to Alternative I.

Table II.B-3 indicates that for most resources, the effects of the agency-preferred alternative are essentially the same as the effects of Alternative I. However, because the agency-preferred alternative defers a portion of the area from Sale 191, it substantially reduces effects to endangered and threatened species, marine and coastal birds, recreation and visual resources, and archaeological resources while reducing effects to the other resources that are proximate to the Lower Kenai Peninsula and the Barren Islands, compared to Alternative I.

The agency-preferred alternative reduces potential effects caused by routine operations. By reducing noise and disturbance from routine operations in the area deferred from leasing, this alternative reduces potential effects to several threatened, endangered, or candidate marine mammal species, including the western stock of Steller sea lions, humpback whales, beluga whales and, possibly but less likely, fin whales. This reduction of noise and disturbance also decreases effects to marine and coastal birds. This alternative eliminates the opportunity of potential archaeological sites in the area deferred by leasing. The alternative eliminates significant visual effects by moving potential platform sites farther offshore from the public viewing areas in the Lower Kenai Peninsula.

The agency-preferred alternative does not change the probability of an unlikely large oil spill occurring. However, this alternative does reduce the potential effects of an oil spill to endangered and threatened species by reducing the chance of exposure from extremely fresh oil. It also removes an area that has a relatively high probability of an unlikely large oil spill impacting important habitat for the endangered Western stock of the Steller sea lion and probable year-round habitat for the Southwest stock of Alaska sea otters. Potential effects to marine and coastal birds are reduced because an unlikely oil spill would occur farther offshore, providing additional time for the oil to weather and for cleanup vessels to reach the spill in the ower Kenai Peninsula and Barren Islands.

We suggest interested readers review the summary Table II.B-3 and the summary of the effectiveness of stipulations in Section II.F.1. Additional information can be found in the full analyses of the effects by resource in Sections IV.B.1, IV.B.3, IV.B.4, and V.C. This information is provided to meet the Council on Environmental Quality regulations and should not be considered as a final decision or as approval of the project. The MMS will develop its final Record of Decision for Sale 191 following the distribution of the final EIS and the Proposed Notice of Sale. The final decision(s) for Sales 191 and 199 and supporting rationale may be different than the agency-preferred alternative.

If the Secretary of the Interior decides to proceed with each of the sales (191 and 199) by not choosing Alternative II – No Lease Sale, the Secretary may choose one, all, some combination, or part of the deferral options that comprise the final Notice for Sale 191. The Secretary will have the full suite of options available for Sale 199 when those decisions are made in 2006. The Secretary may choose the same options selected for Sale 191 or different options.

SECTION III

DESCRIPTION OF THE
AFFECTED ENVIRONMENT

CONTENTS OF SECTION III

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

Section III – Affected Environment succinctly describes the relevant resources of the areas that would affect or would be affected by the alternatives if they were implemented. This section describes the baseline conditions against which the decisionmaker and the public can compare the effects of all action alternatives.

III.A. PHYSICAL CHARACTERISTICS

The following resource categories describe the physical environment:

- Quaternary Geology
- Climate and Meteorology
- Oceanography
- Water Quality
- Air Quality

III.A.1. Quaternary Geology

III.A.1.a. Regional Geology

Lower Cook Inlet is a tidal embayment of the North Pacific Ocean that projects north-northeast for more than 240 kilometers into the Southcentral Alaska coast. Lower Cook Inlet narrows to the north from a maximum width of 140 kilometers near Kamishak and Kachemak Bays to 50 kilometers near Kalgin Island. The inlet lies between the Chugach and Kenai Mountains on the southeast, the Talkeetna Mountains on the northeast, and the Alaska-Aleutian Range on the northwest. Lower Cook Inlet is connected to the southwest with Shelikof Strait, which extends for another 270 kilometers to a juncture with the North Pacific Ocean. In the southeast, the inlet opens to the Gulf of Alaska through the Stevenson and Kennedy Entrances flanking the Barren Islands. For more information on the regional geology including volcanism and seismicity see USDOI, MMS, Alaska OCS Region, 1995:Figure III.A-1.

Lower Cook Inlet and Shelikof Strait are structural geologic basins formed by plate-subduction tectonics (Plafker, Moore, and Winkler, 1994; Hampton, 1982a,b; Bruhn, Parry, and Bunds, 2000). These structural lows and the mountains surrounding them have been sculpted into their present morphology primarily by the direct or indirect action of glaciers (Miller and Dobrovolny, 1959; Karlstrom, 1964). The processes responsible in the past for shaping the geomorphology of this region are active today: earthquakes, faulting, volcanism, ice fields, alpine glaciation, tsunamis, and high-velocity tidal currents. Several historically active volcanoes line the northwestern side of Cook Inlet and Shelikof Strait (USDOI, MMS, Alaska OCS Region, 1995:Figure III.A.1-1); north to south they include Mount Spurr (which erupted in 1953 and 1992); Mount Redoubt (which last erupted in 1989-1990); Mount Iliamna (which has had numerous steam and ash eruptions); Mount Augustine (with historic eruptions in 1812, 1883, 1902, 1935, 1963-1964, 1976 and 1986); and Mount Katmai/Novarupta (which last erupted in 1912) (Waythomas and Miller, 1999; Waythomas et al., 1997; Waythomas and Waitt, 1998; Feirstein and Hildreth, 2000). The mountains and lowlands surrounding Cook Inlet and Shelikof Strait exhibit the full range of glacial features including ice fields; active alpine glaciers; arêtes; horns; hanging valleys; U-shaped valleys; drumlins; erratic boulders; outwash plains; deltas; eskers; glacial lakes; and ground, terminal, medial, and lateral moraines.

The offshore geology of Cook Inlet and Shelikof Strait also displays evidence of past sea-level fluctuations, volcanic activity, faulting, and glaciations. High-resolution seismic data from lower Cook Inlet reveal seafloor and subsurface features originating from glaciers and modified by high tidal currents and Holocene marine deposition (Whitney et al., 1979; Whitney, Noonan, and Thurston, 1981; Thurston, 1985; Thurston and Choromanski, 1995). The seafloor features include sand waves, megaripples, sand ribbons, lag gravel, ice-rafted boulders with associated comet marks, and volcanic debris flows. The subsurface features include terminal, lateral, and ground moraines; lacustrine, glaciofluvial, and glaciomarine deposits; drainage channels; tunnel valleys; eskers; outwash fans; and sand waves. High-resolution geophysical data from Shelikof Strait reveal extensive deposits of Pleistocene glaciomarine and Holocene marine deposits. The Shelikof Strait seafloor generally is featureless with the exception of a few tectonic structures, such as fault scarps and possible remnant volcanic features (Hoose and Whitney, 1980).

III.A.1.a(1) Late Pleistocene and Holocene Chronology

Five major Pleistocene glaciations have been recorded in the region (Karlstrom, 1964). These glaciations and the age of their maximum advances are the Mount Susitna (200,000-230,000 Before Present [B.P.]), the Caribou Hills (155,000-190,000 B.P.), the Eklutna (90,000-110,000 B.P.), the Knik (50,000-65,000 B.P.), and the Naptowne (5,500-20,000 B.P.) (Reger, Combellick, and Brigham-Grette, 1995). There also is abundant evidence of the “Little Ice Age” advance in the Holocene, which has been termed the Alaskan glaciation by Karlstrom (1964). The late Pleistocene and Holocene events are the focus of this summary, because prehistoric cultural occupation occurred during this time interval.

The Holocene and late Pleistocene glacial chronology of the Cook Inlet region is depicted in USDOI, MMS, Alaska OCS Region (1995:Table F-1).

III.A.1.a(2) Extent of Glaciations

During the first three glaciations (Mount Susitna, Caribou Hills, and Eklutna), ice completely filled the Cook Inlet trough to elevations of 650-1,300 meters, extending from the Talkeetna Mountains in the north through Cook Inlet and Shelikof Strait out to the edge of the continental shelf. Evidence for this distribution is the presence of ice-erosional landforms and the stratigraphic position and relative elevations of moraines in surrounding mountains and lowlands of the Cook Inlet region (Karlstrom, 1964). In addition, evidence from seismic surveys in lower Cook Inlet and Shelikof Strait, such as glacial erosion and moraine deposits, attests to the presence of glaciers in the offshore areas during lower sea level stillstands. On the Kodiak shelf, ubiquitous ground moraine deposits and glacially eroded bedrock are evidence that ice covered the continental shelf during these early glacial advances (Thrasher, 1979). During the last two glaciations (Knik and Naptowne), ice coalesced across the lower Cook Inlet trough and filled Shelikof Strait out to the continental shelf (USDOI, MMS, Alaska OCS Region, 1995:Figure F-2; Karlstrom, 1964; Whitney et al., 1979).

III.A.1.a(3) Late Wisconsin Sea-Level Stillstands

Past sea-level stands have been calculated for the Cook Inlet region from lowland-coastal bog and tidal bog stratigraphy, which record past water-table levels, and radiocarbon dating of organic material (Karlstrom, 1964; Reger, Combellick, and Brigham-Grette, 1995).

Sea-level stillstands have been deduced from analysis of bathymetry (Dixon, Sharma, and Stoker, 1979; Dixon, Stoker, and Sharma, 1986). Relative depths of seafloor features, such as benches, sills, and closed depressions, are related to sea-level stillstands. Using this method, stillstands have been postulated for six isobath lines at -125 meters, -82 meters, -66 meters, -55 meters, -38 meters, and -28 meters. Stillstands are thought to be associated with periods of maximum glaciation when relatively lower sea levels prevailed. The six isobaths, therefore, were correlated to regional and worldwide glacial maximums (Dixon, Sharma, and Stoker, 1979; Dixon, Stoker, and Sharma, 1986) and assigned the following ages: -125 meters from between 21,500 and 18,000 B.P.; -82 meters from between 15,000 and 14,800 B.P.; -66 meters at about 13,750 B.P.; -55 meters at about 12,700 B.P.; -38 meters from between 9770 and 9330 B.P.; and -28 meters at about 8700 B.P.

In lower Cook Inlet, a prominent notch is identified on seismic profiles along the western limb of the bathymetric ramp between Kamishak and Kachemak bays (Thurston and Choromanski, 1995). The notch lies at a depth of -65 meters (USDOI, MMS, Alaska OCS Region, 1995:Figures F-7 and F-10) and may correspond to the -65-meter stillstand of Dixon, Sharma, and Stoker (1979) and Dixon, Stoker, and Sharma (1986). Outwash fans from glacial streams that reached their erosional base level also formed in the area of the ramp and are evident in water depths of about -65 to -80 meters (USDOI, MMS, Alaska OCS Region, 1995:Figures F-4 and F-10).

III.A.1.b. Offshore Geology

III.A.1.b(1) Bathymetry

In Federal waters, bathymetric relief ranges from less than 10 meters near Kalgin Island in the north to greater than -240 meters along the southeastern side of northern Shelikof Strait (Map 1, Figure III.C-25). Lower Cook Inlet generally is configured as a two-tier plateau, with the shallower (less than -90 meters) northern part separated from the deeper (greater than 90 meters) southern part by an arcuate, open-to-the-south “ramp” feature (Bouma et al., 1977; Whitney et al., 1979). The northern tier is dissected by a 45-meter deep central sea valley, which bifurcates in the north around Kalgin Island, and by the “Kachemak” channel, which forms the axis of Kachemak Bay. The northern plateau area also is covered with seafloor bedforms (Whitney et al., 1979; Thurston and Choromanski, 1995), including sand waves with amplitudes approaching 15 meters (USDOI, MMS, Alaska OCS Region, 1995:Figure F-3).

The southern tier is characterized by shallower slopes and deep, closed basins (USDOI, MMS, Alaska OCS Region, 1995:Figure F-4) separated by narrow ridges, such as the ridge defined by the -125-meter isobath that connects the Barren Islands to the Kenai Peninsula and Shuyak Island (USDOI, MMS, Alaska OCS Region, 1995:Figure F-5). At water depths shallower than this ridge, Cook Inlet is connected to Prince William Sound waters to the southeast via the Kennedy and Stevenson entrances. Cook Inlet is open to the southwest and continues as Shelikof Strait. The seafloor of the northwestern side of Shelikof Strait exhibits relatively steep slopes descending from the mountain front with water depths of around -100 meters.

III.A.1.b(2) Geomorphology

A study of bathymetry and subsurface deposits (Thurston, 1985; Thurston and Choromanski, 1995) resulted in the classification of lower Cook Inlet morphology into four provinces (Map 1, Figure III.C-25):

I. 0 to -60 meters, constructional morphology, glacial deposition and subordinate erosion
II. -60 to -120 meters, constructional morphology, glacial and marine deposition with subordinate hydraulic erosion
III. -120 to -190 meters, erosional morphology, gently sloping seafloor formed by glacial erosion and subordinate glaciomarine deposition
IV. deeper than -190 meters, erosional morphology, closed basins formed by glacial erosion and subordinate glaciomarine deposition

Geomorphological Provinces I and II correspond to the area of the northern bathymetric tier and the ramp. Geomorphological Provinces III and IV correspond to the southern bathymetric tier and Shelikof Strait. Bathymetric characteristics of the northern part of lower Cook Inlet are manifestations of thick deposits of glacial, glaciofluvial, and glaciomarine strata. The ramp feature is the bathymetric manifestation of merging terminal moraines and other morainal lobes deposited by ice from Kachemak and Kamishak bays and larger glaciers moving southwest down the inlet. The bathymetric profile of the southern plateau and

Shelikof Strait is due to deep scour by glaciers and thin Pleistocene and Holocene marine and glaciomarine sediment cover.

III.A.1.b(3) Quaternary Deposits

The Quaternary unconformity is present throughout the sale area (Thurston, 1985). The surface was eroded into underlying rock by ice flowing out of Cook Inlet and Shelikof Strait. It is characterized by truncated tilted Tertiary strata overlain in the north by unstratified or poorly stratified moraine or till deposits in the north and by stratified glaciofluvial, glaciomarine, and marine sediments in the south. The relative depth of the unconformity surface is a direct measure of the intensity of ice erosion and, by inference, ice depth. The greatest relief exhibited by the unconformity surface in lower Cook Inlet occurs north of Cape Douglas, where it lies at -250 meters, and southwest of the Barren Islands, where it lies at depths of -300 meters. These areas of deep ice scour correspond to the route of thick ice tongues that flowed into lower Cook Inlet and Shelikof Strait from the Alaska-Aleutian Range and from what appears to have been a spreading center on the site of the Barren Islands. An isopach map of Quaternary sediment shows that the area of thickest Quaternary deposits also occurs where the unconformity surface is at its deepest level (Thurston, 1985).

Quaternary deposits consist of ground moraine and drift deposits; lateral and terminal moraines; outwash sediments; and glaciofluvial, glaciomarine, lacustrine, and marine sediments. Seafloor sediments have been sampled and their distribution mapped (Bouma et al., 1977). Generally, the northern area is mantled by coarse sand and gravel; the mid-inlet is covered by medium- to fine-grained sand that is sculptured into bedforms; and the southern inlet and Shelikof Strait are covered by fine-grained sand, silt, and clay.

Sediment sources are spatially determined within the Cook Inlet trough, as indicated by microtexture analyses of bottom sediments (Hampton et al., 1978). These studies indicate that quartz grains in the northern part of lower Cook Inlet showed characteristics of unaltered glacial affiliation. Bottom quartz grains in the central sand-wave area show characteristics of glacial deposits altered by hydraulic reworking. Seafloor sediments in the west and south show chemical overgrowth over a glacial texture, which is indicative of high-residency time in a low-energy environment. Clay mineralogy studies (Hein, Bouma, and Hampton, 1977) indicate that suspended sediment sampled from the eastern side of the inlet was derived from the Copper River, which flows into Prince William Sound to the east. These sediments are carried by the counterclockwise Alaska gyre into the inlet via the Kennedy and Stevenson Entrances, where they travel up the east side of lower Cook Inlet. Suspended sediments sampled on the western side of the inlet have Susitna and Matanuska River mineralogical characteristics.

III.A.1.b(4) Seafloor Features

The seafloor of lower Cook Inlet is characterized by a wide variety of bedforms and other geomorphic features (USDOI, MMS, Alaska OCS Region, 1995:Figure F-6). The seafloor of Shelikof Strait generally is featureless with the exception of some tectonic relief (Hoose and Whitney, 1980).

III.A.1.b(4)(a) Lag Gravel

Areas of the northern lower Cook Inlet near Kalgin Island are covered with lag gravel. These sediments were deposited by glaciers and subsequently winnowed of their fine- and medium-sized particles. Microtexture analysis of sediment grains indicates that these deposits display textures associated with unaltered glacial sediment (Hampton et al., 1978).

III.A.1.b(4)(b) Sand Ribbons

Sand ribbons are found in the northern and central lower Cook Inlet in areas flanking the sand-wave field and the central and Kachemak channels. These bedforms consist of strips of sand oriented generally north-south, parallel to the prevailing tidal currents. The strips of sand are separated by lag gravel and support sand ripples, which are oriented transverse to the current direction. Sand ribbons are believed to form in bottom areas where currents are moderately higher than the minimum to entrain sand grains and where there is a limited supply of sand.

III.A.1.b(4)(c) Sand Waves

The lower Cook Inlet sand-wave field covers approximately 850 square kilometers of the seafloor (Whitney et al., 1979). These bedforms reach amplitudes of 15 meters and wavelengths of 600 meters. Sand waves occur in water depths ranging from less than -40 meters to more than -120 meters. A study of the sand-wave dynamics using comparative sidescan-sonar images and seismic profiles after a 4- and 5-year period showed no evidence that these large bedforms migrate (Whitney et al., 1979; Whitney, Noonan, and Thurston, 1981). Sand grains are known to move in response to the tidally induced bottom currents (Bouma et al., 1979), which can reach 1 knot in the central inlet area, and microtexture analysis, which indicates reworking of these sediments; however, bedform-migration studies and the absence south of the ramp of microtextures of the sand-wave-field type indicate that there is no net movement of bedforms or sediments. Sand waves in deepwater, where currents may not be strong enough to form such features, and the presence of buried sand waves near the apex of the ramp suggest the possibility that the sand-wave field is at least partially relict.

III.A.1.b(4)(d) Comet Marks

Comet marks are formed by the creation of an erosional tail of lag gravel behind an obstruction on the seafloor (Thurston, 1985). These features are interpreted as having at their head an ice-rafted boulder that lies in a shallow depression and has a tail of coarse material pointing away, downcurrent. The circulation pattern in lower Cook Inlet indicated by these features is counterclockwise in the southern deeper part and generally south along the west side of the inlet (USDOI, MMS, Alaska OCS Region, 1995:Figure F-5).

III.A.1.b(5) Subsurface Features

III.A.1.b(5)(a) Moraines

Northern Inlet: Kalgin Island, just north of the planning area boundary, is a terminal moraine from an ice lobe that flowed east from the Alaska Range into Redoubt Bay. The Quaternary unconformity in the northern lower Cook Inlet is covered by unstratified, hummocky, mounded, and heavily dissected strata that are most likely ground moraine and till deposits. There are several stratigraphic intervals represented in these types of deposits.

Central Inlet: The geomorphological structure called the ramp (Bouma et al., 1978a) has an inverted V-shape (in map view) and exhibits bathymetric relief of more than -60 meters. The ramp is formed by the joining of two moraines: the Kamishak Bay moraine forms the western limb, and the Kachemak Bay moraine forms the eastern limb (Thurston, 1985). In cross-section, the moraines have a dome shape (USDOI, MMS, Alaska OCS Region, 1995:Figure F-6). The position of these moraines indicates the maximum advance of ice into the midpart of the inlet during the Knik and Naptowne maximums. The Kamishak Bay moraines appear to have been deposited by ice flowing northeast out of the Cape Douglas area and/or from the west into Kamishak Bay. This moraine complex is composed of an inner and an outer spatulate-shaped belt (USDOI, MMS, Alaska OCS Region, 1995:Figure F-7). The outer belt represents the terminal phase of ice advance and the inner belt may be a recessional phase of the same advance, or a later, less-intense advance. The Kachemak Bay moraine generally is not as well preserved as those in the west. It forms an arcuate mound with a domal cross-section for most of its discernible length.

Southern Inlet: In water deeper than -100 meters, moraines are found around the western side of the Barren Islands (USDOI, MMS, Alaska OCS Region, 1995:Figure F-7). These moraines are well preserved and exhibit domal cross-sections.

III.A.1.b(5)(b) Channels

A network of buried channels is present in the central part of lower Cook Inlet. Buried channels are absent south of the ramp. These channels are discontinuous and branching, and they dissect different stratigraphic levels. Buried channels fit into one of three categories:

1. **Glacial channels or valleys** (USDOI, MMS, Alaska OCS Region, 1995:Figure F-8) exhibit a U-shaped profile and are generally wider and more continuous than hydraulic channels. They are the predominate type of channel observed in the northernmost area.

2. **Tunnel valleys** were subice glacial-drainage channels. These channels generally are characterized by the presence of eskers, ice-contact stream deposits, which form sinuous mounds of unstratified sediments in the central channel (USDOI, MMS, Alaska OCS Region, 1995:Figure F-9).
3. **Glacial outwash stream channels**, which formed in front of the glacier and carried meltwater to the Pacific Ocean, are characterized by cut-and-fill structures, short and discontinuous courses, and multiple or overlapping channels. Because of their relative position at the apex of the ramp, these channels may be, in part, due to streams formed when the ice damming lower Cook Inlet was breached and water from the large pro-glacial lake broke out and flowed to the sea.

III.A.1.b(5)(c) Outwash Fans

At the apex of the ramp where the Kamishak and Kachemak moraines meet, there are distinct delta-type outwash fans (USDOI, MMS, Alaska OCS Region, 1995:Figures F-4 and F-10). These fans are interpreted to have formed as the result of glacial outwash streams dumping their sediment bedload at the paleoshoreline. The present depth of these fans indicates that they were formed at the shoreline during a sea-level lowstand or stillstand of from 65 to -80 meters. This depth range is in general agreement with stillstand depths of -66 meters and -82 meters proposed by Dixon, Sharma, and Stoker (1979) and Dixon, Stoker, and Sharma (1986).

III.A.1.b(5)(d) Sand Waves

Large sand waves in the area of the apex of the ramp are buried beneath outwash and glaciomarine deposits (USDOI, MMS, Alaska OCS Region, 1995:Figure F-11).

III.A.1.b(5)(e) Lacustrine Sediments

Covering the inner belt and deposited against the inner wall of the outer belt of the Kamishak Bay moraine, seismically transparent strata of uniform thickness mimic underlying topography (USDOI, MMS, Alaska OCS Region, 1995:Figure F-6). The uniform thickness of these deposits, even over terrain relief, indicates a low-energy depositional environment, and the seismic “transparency” indicates that the deposits are texturally homogenous. These are characteristics of lacustrine deposits. The proximity to Augustine Island may mean that these deposits are ash laid down in a low-energy depositional environment. These probably represent lacustrine deposits laid down in a lake formed by damming of meltwater runoff by the outer morainal belt.

Summary: During the Naptowne Glaciation, sea-level stillstands occurred at approximately 18,000-21,500 B.P. (-125 meters), 14,800-15,000 B.P. (-82 meters), 13,700 B.P. (-66 meters), 12,700 B.P. (-55 meters), 9,770-9,330 B.P. (-38 meters), and 8,700 B.P. (-28 meters). The southeast-facing slope of the outer Kamishak Bay moraine on the west side of Cook Inlet has been notched by water at a still stand of -65 meters, placing the age of the outer moraine feature at pre-Skilak Advance (older than 12,500 B.P.). Outwash fans, which are younger than the south-facing outer Kamishak Bay moraines, also occur at -65 to -80 meters, corresponding to ages of 12,700-15,000 B.P. The inner moraine complex stands at a higher relative elevation than the outer moraine and is undoubtedly younger.

Effects of isostatic rebound and vertical tectonic movements have not been well documented in the Cook Inlet region. According to Dixon, Stoker, and Sharma (1986), there was some tectonic uplift associated with beach deposits on the western side of the inlet. The apparent rise of Augustine Island volcano in the last 10,000 years may have affected the relative elevation of the western side of the inlet. The Alaska earthquake of 1964 resulted in up to 0.6 meters of tectonic subsidence of the Cook Inlet and Shelikof Strait region. Geomorphological evidence suggests that the area of the Kenai Mountains may have subsided substantially since the Wisconsin maximum glaciation (Mobley et al., 1990).

Ice scour and moraine deposits of various types and ages on the shelf and the absence of moraine deposits in the Shelikof Strait attest to the fact that ice completely filled Shelikof Strait and spilled out to the continental shelf during the Moosehorn and Killey advances.

Ice-rafted boulders forming comet marks in the deepwater of lower Cook Inlet indicate that the last ice retreating from the trough formed tidewater glaciers.

Sand waves in the central inlet may have formed at lower sea-level stands (-65 meters) and been stranded in deeper water by a rapid rise in sea level after the last major ice advance. This is suggested by the buried sand waves and by studies, which could not substantiate significant migration of specific mega-bedforms (Whitney et al., 1979; Whitney, Noonan, and Thurston, 1981).

III.A.2. Climate and Meteorology

In the lower Cook Inlet region, the climate is transitional from a maritime to a continental climate. Generally, lower Cook Inlet is a maritime climate, wetter and warmer than the upper Cook Inlet region, which exhibits some continental climatic features—that is, the upper Cook Inlet region is drier and cooler than the lower.

Overland and Heister (1980) define six Gulf of Alaska weather types that influence lower Cook Inlet. The Aleutian low-pressure center occurs most often. The Aleutian Low, a semipermanent low-pressure system over the Pacific Ocean, has a strong effect on the climate in the area. As this low pressure area moves and changes in intensity, it brings storms with wind, rain, and snow (Wilson and Overland, 1986). The other weather types are the low-pressure center over central Alaska; the stagnating low off of Queen Charlotte Islands; and the Pacific Anticyclone, also known as the East Pacific High (Overland and Hiester, 1980). Generally, winter is characterized by an inland high-pressure cell with frequent storm progressions from the west along the Aleutian chain. During summer, a low-pressure cell is over the inland area, with fewer storms. Spring and fall are characterized by a transition between these generalized patterns (Macklin, 1979).

For More Information on Climate and Meteorology: The EIS's for MMS sales from the lower Cook Inlet-Shelikof Strait (Lease Sale 60) and the Gulf of Alaska/Cook Inlet (Lease Sale 88) and the Cook Inlet Lease Sale 149 Final EIS discuss the regional meteorology of the lower Cook Inlet (USDOI, Bureau of Land Management [BLM], Alaska OCS Office, 1981; USDOI, MMS, Alaska OCS Region, 1984, 1995).

III.A.2.a. Air Temperature

Monthly average air temperatures for the Cook Inlet multiple-sale area rise above freezing from mid-April to the end of October. Even during these months, air temperature on any day may vary from near 0-20 °Celsius. July typically is the warmest, with an average air temperature onshore of about 12-19 °Celsius and offshore of 11-13 °Celsius. December through February usually are the coldest months. Figures III.A-1, III.A-2, III.A-3, and III.A-4 show the seasonal variation of the mean monthly air-temperature maximums and minimums, over the period of record for Anchorage, Kenai, Homer, and Kodiak, Alaska. Air temperatures generally remain below freezing for 4 months of the year. Superstructure icing can occur throughout the lower Cook Inlet region.

III.A.2.b. Precipitation

Precipitation decreases from south to north along the inlet. Kodiak is the wettest, and Anchorage is drier. Homer, Kenai, and Anchorage all have substantially less precipitation than Kodiak due to the sheltering or "rain shadow" effect of the Kenai Mountains. Homer averages about 65 centimeters of precipitation annually, and Anchorage averages about 40 centimeters. The wettest months are September and October, with the relatively dry conditions in April through July. In the northern inlet, precipitation usually falls as snow from October to April and as rain the rest of the months. Farther south in the inlet, a greater percentage of the precipitation falls as rain. Figures III.A-1, III.A-2, III.A-3, and III.A-4 show the seasonal variation of the mean multiyear average of precipitation and snowfall over the period of record for Anchorage, Kenai, Kodiak, and Homer.

III.A.2.c. Winds

The atmospheric forcing is influenced by storm systems. These storms have lives of a few days, but their frequency and intensity vary of time scales of weeks to decades (Stabeno et al., In press). Lower Cook Inlet and Shelikof Strait winds respond to the large-scale weather patterns but with important modifications caused by the topography of the surrounding mountains (Macklin, Lindsay, and Reynolds, 1980). The rough terrain encircling the inlet on three sides often interacts with larger scale winds and pressure gradients to produce highly variable wind regimes on scales of a few kilometers.

Cook Inlet and Shelikof Strait are framed by mountains on the east and west with only small breaks. On the western side of Cook Inlet are the Alaska and Aleutian (Alaska Peninsula) ranges; on the eastern side are the Talkeetna, Chugach, and Kenai mountains and the Kodiak and Afognak Islands lesser ranges. The nearly continuous Alaska Peninsula mountains act as a barrier to winds broken only by Kamishak Gap, a low-lying area between Iliamna Lake and Kamishak Bay. Kennedy and Stevenson entrances in lower Cook Inlet are major breaks in the eastern mountains from the Kenai Peninsula to the Kodiak-Afognak Islands Group. The inlet's and strait's mountainous borders not only block low-level airflow east and west but also form airflow channels north and south.

There are two main types of winds: gap winds and drainage winds. Gap winds can be subdivided further into mountain (orographic) channeling and mountain gap winds.

III.A.2.c(1) Gap Winds

A gap wind is a wind flowing from areas of high-pressure systems to areas of low-pressure systems along the sea-level channel (Overland and Walter, 1981). Gap winds are observed over Cook Inlet (Macklin, Lindsay, and Reynolds, 1980; Macklin, Overland, and Walker, 1984; Gray 1988; Macklin, 1988; Lackmann and Overland, 1989; Macklin, Bond, and Walker, 1990).

III.A.2.c(1)(a) Mountain (Orographic) Channeling

The mountains surrounding lower Cook Inlet form two wind channels (Macklin, Bond, and Walker, 1990). The north-south channel is formed by Cook Inlet, and the east-west channel is formed by Kamishak Gap, Kamishak Bay, and Kennedy and Stevenson entrances. Low-level winds are constrained to these two channels (Macklin, 1979; Macklin, Overland, and Walker, 1984; Macklin, Bond, and Walker, 1990). Pressure-gradient-driven airflow in these channels may explain 84% of the measured Cook Inlet surface airflow (Macklin, 1979).

Wind-direction series indicate four prevalent surface-wind directions, down the channel from south-southeast during winter, up the channel north-northwest during summer, and cross-channel from the northeast and the southwest (Macklin, 1979). Typical average monthly offshore wind speeds are 8 to 10 meters per second (15.6-19.5 knots) in winter and 5-10 meters per second (9.7-19.5 knots) in summer (Hsu, 1988; Brower et al., 1988).

III.A.2.c(1)(b) Mountain-Gap Winds

Mountain-gap winds blowing through the Alaska Peninsula mountains differ from sea-level channel-gap winds because of the gravitational acceleration associated with the seaward-sloping terrain (Macklin, Bond, and Walker, 1990). Alaska's large-scale weather patterns produce mountain-gap winds blowing from the western Alaska Peninsula to the eastern side through passes, valleys, and gaps. Mountain-gap winds occur through Kamishak Gap throughout the year but are most prevalent in the winter, occurring several times a month (Macklin, 1988; Macklin, Bond, and Walker, 1990). Mountain-gap winds can have velocities greater than 51 meters per second (99.2 knots) over the Barren Islands (Macklin, 1988). Mountain-gap winds create williwaws and waterspouts that can create hazardous conditions for mariners and aviators.

III.A.2.c(2) Drainage (Katabatic) Winds

The mountain- channeled winds are influenced by small-scale features such as drainage winds (cold air mass moving downslope) and wake flow. Drainage winds occur along Cook Inlet's mountainous southeastern and western coasts draining from glaciated valleys (Macklin, 1979). Kachemak Bay exhibits drainage winds, because several Kenai Peninsula glaciers terminate at its eastern end (Reynolds, Macklin, and Walter, 1979). In winter, cold continental air drains from the mountainous regions surrounding northern Cook Inlet. Drainage-wind velocities can exceed 50 meters per second (97.2 knots) and extend for tens of kilometers offshore (Reynolds, Macklin, and Hiester, 1981). Wind flow around Mount Augustine has been characterized as wake flow with typical velocities from 3-8 meters per second (5.8-15.6 knots) (Macklin, Lindsay, Reynolds, 1980; Macklin, 1979).

Storm-surge development is unfavorable in most of lower Cook Inlet due to the rugged topography and steeply sloping seafloor (Wise, Comiskey, and Becker, 1981). However, the open-water stretch from Shelikof Strait to lower Cook Inlet can develop storm surges with west-southwest winds during the fall and winter, when wind strength is sufficient.

III.A.3. Oceanography

This section presents revised and updated information from the lower Cook Inlet Planning Area Oil and Gas Lease Sale 149 final EIS (USDOI, MMS, Alaska OCS Region, 1995), hereby incorporated by reference.

Lower Cook Inlet circulation is affected by its location within the Gulf of Alaska. The lower Cook Inlet connects to the Gulf of Alaska through Kennedy and Stevenson entrances and Shelikof Strait. The generalized regional circulation is shown in the inset in Figure III.A-5.

The easterly flowing North Pacific Current divides into the north-flowing Alaska Current and the south-flowing California Current. In the eastern Gulf of Alaska, the Alaska Current forms an approximately 400-kilometer-wide, offshore, counterclockwise flow, with surface velocities approximately 30 centimeters per second. In the western Gulf of Alaska, where the current is named the Alaskan Stream, the width decreases to less than 100 kilometers wide, and surface velocities increase, ranging up to 100 centimeters per second (Reed and Schumacher, 1989a,b). The Alaskan Stream volume transport is 12-15 million cubic meters per second and shows no significant seasonal variation (Reed, Muench, and Schumacher, 1980; Reed, 1984).

The lower portion of Cook Inlet is influenced by the Alaskan Stream and by a parallel current in the western Gulf of Alaska called the Kenai Current or the Alaska Coastal Current. The Alaska Coastal Current flows along the inner shelf in the western Gulf of Alaska and enters Cook Inlet and Shelikof Strait (Schumacher and Reed, 1980; Royer, 1981a,b). It is a narrow (less than 30 kilometers), high-speed (20-175 centimeters per second) flow that is driven by freshwater discharge and inner-shelf winds (Royer, 1981a,b, 1982; Reed and Schumacher, 1989a,b). Peak velocities of 175 centimeters per second occur in September through October (Johnson, Royer, and Luick, 1988). The Alaska Coastal Current transport volume ranges from 0.1-1.2 million cubic meters per second and varies seasonally in response to freshwater runoff fluctuations, regional winds, and atmospheric pressure gradients (Luick, Royer, and Johnson, 1987; Royer, 1981a,b, 1982; Reed, Schumacher, and Incze, 1987; Schumacher and Reed, 1980, 1986; Schumacher, Stabeno, and Roach, 1989). Oxygen isotope measurements in late summer show that glacial meltwater may provide much of the total freshwater runoff into the Alaska Coastal Current (Kipphut, 1990). The Alaska Coastal Current was the dominant transport process affecting oil leaving Prince William Sound during the *Exxon Valdez* oil spill (Galt and Payton, 1990; Galt, Lehr, and Payton, 1991). Oil moved approximately 10-13 kilometers per day with the Alaska Coastal Current, which is considered slow, due to the low freshwater discharge in March and April 1989 (Galt, Lehr, and Payton, 1991).

III.A.3.a. Lower Cook Inlet

III.A.3.a(1) Circulation

Cook Inlet is a complex Gulf of Alaska estuary. An estuary is defined as a semienclosed coastal body of water having a free connection to the open sea and within which the seawater is measurably diluted with freshwater deriving from land drainage (Cameron and Pritchard, 1963). Cook Inlet has marine connections with Shelikof Strait and the Gulf of Alaska, has terrestrial source waters including numerous large rivers, and is characterized by estuarine-like circulation (Muench, Mofjeld, and Charnell, 1978).

The generalized lower Cook Inlet mean circulation is shown in Figure III.A-5. A southward flow along western lower Cook Inlet is due to the Coriolis force acting on freshwater entering upper Cook Inlet from rivers (Rosenberg et al., 1967; Gatto, 1976; Muench, Mofjeld, and Charnell, 1978). The three primary rivers are the Susitna, Matanuska, and Knik Rivers with a combined peak discharge of about 90,000 cubic meters per second that occurs in July through August (Sharma et al., 1974). Northern Cook Inlet salinity, temperature, and suspended-sediment concentrations change significantly with the season and reflect variations in the upper Cook Inlet freshwater input (Sharma et al., 1974).

The Alaska Coastal Current and deeper water enter Cook Inlet from the Gulf of Alaska through Kennedy and Stevenson entrances, then flow northward along the eastern side of the inlet as well as westward along the 100-meter isobath, turning south near Cape Douglas (Sharma et al., 1974; Burbank, 1977; Muench, Mofjeld, and Charnell, 1978; Muench and Schumacher, 1980; Muench, Schumacher, and Pearson, 1981). Westerly mean flow during winter is approximately 20 centimeters per second with south flow approximately 5-10 centimeters per second (Muench and Schumacher, 1980). In summer, westerly flow is slower, and southerly flow is faster (Muench and Schumacher, 1980). Surface circulation is controlled by the seasonally varying freshwater outflow, with Alaska Coastal Current water traveling farther north during periods of less freshwater input (Science Applications, Inc., 1979).

The relatively fresh turbid upper Cook Inlet outflow meets and mixes with incoming Alaska Coastal Current water in the central inlet. This mixture flows along the western Cook Inlet and outflows to Shelikof Strait (Muench and Schumacher, 1980). During fall and winter, when freshwater inputs to Cook Inlet are lower, a clockwise gyre can develop around Kalgin Island, lengthening water retention time in the upper inlet (Whitney, 2000; Russell, 2000).

The instantaneous current field is characterized by wind-driven currents and tidal currents that vary from prominent (principal lunar component M2, amplitude of 80 centimeters per second) in the eastern lower inlet to weaker (M2 amplitude of 40 centimeters per second) in the central and western inlet (Muench and Schumacher, 1980; Isaji and Spaulding, 1987).

III.A.3.a(2) Tides

In Cook Inlet, mixed tides are the main surface circulation driving force. Two unequal high and low tides occur per tidal day (24 hours, 50 minutes), with the mean range increasing northward (Figure III.A-6). Mean diurnal range is 5.8 meters (19.1 feet) on the east side of the inlet and 5.1 meters (16.6 feet) on the west (Rosenberg et al., 1967; Science Applications, Inc., 1979; USDOC, National Oceanic and Atmospheric Administration [NOAA], National Ocean Survey, 1992). Tidal currents reach 102-153 centimeters per second in the lower Cook Inlet entrance, and speeds greater than 335 centimeters per second occur at the narrows (Mungall, 1973; Gatto, 1976).

III.A.3.a(3) Upwelling/Fronts/Convergences

Detailed information on localized processes is lacking, but their occurrence in specific areas has been described in the literature. Upwelling occurs along the outer Kenai Peninsula coast northwest of the Chugach Islands. The upwelled water enters Kachemak Bay, promoting high productivity (Science Applications, Inc., 1979). Fronts occur as Gulf of Alaska water encounters freshwater outflow from the upper Inlet. These zones, termed “rips,” are convergence zones, locations of debris accumulation. Although the number of recorded observations is small, downward velocities as high as 10 centimeters per second have been measured, which are fast enough to temporarily and locally overcome the buoyancy of surface debris or oil (Johnson, Okkonen, and Sweet, 2000). Convergence zones in rip locations have been mapped from a combination of satellite imagery and conversations with local anglers (Haley et al., 2000; Wilson and Tomlins, 2000; Burbank, 1977; Map 2).

III.A.3.a(4) Sea Ice

Pack ice, shorefast ice, stamukhi (i.e., layered "ice-cakes" formed by stacking of ice floes on shorefast ice over multiple high tides), and estuarine/river ice are the four ice types in Cook Inlet. Sea ice is most prevalent in the sale area during winter (LaBelle et al., 1983; Brower et al., 1988; Mulherin et al., 2001).

In Cook Inlet, the amount of sea ice varies annually. In general, sea ice forms in October to November, increases from October to February from the West Foreland to Cape Douglas, and melts in March to April (Figures III.A-7 through III.A-14). Sea-ice formation is controlled in upper Cook Inlet primarily by air temperature and in lower Cook Inlet by the temperature and inflow rate of the Alaska Coastal Current (Poole and Hufford, 1982).

III.A.3.a(5) Temperature

Temperature varies from approximately 11 °Celsius at the entrance of lower Cook Inlet to approximately 10 °Celsius between the Forelands (Rosenberg et al., 1967; Sharma et al., 1974; Kinney, Groves, and Button, 1970; Feely et al., 1979; Muench, Mofjeld, and Charnell, 1978). Western Cook Inlet water is cooler in the spring and warmer in the fall than incoming oceanic water from the Gulf of Alaska (Feely et al., 1980).

III.A.3.b. Shelikof Strait

III.A.3.b(1) Circulation

The flow in Shelikof Strait is complex and varies over small time and space scales (Reed and Schumacher, 1989a,b). The general circulation pattern is modified locally in response to meteorological conditions. Shelikof Strait has an estuarine-like circulation with deep water from the south flowing north (Reed, Schumacher, and Incze, 1987).

Mean surface circulation through Shelikof Strait generally is to the southwest along the Alaska Peninsula in response to the outflow from Cook Inlet and the inflow of Alaska Coastal Current water from Kennedy Entrance. The southwest flow merges with the Alaskan Stream approximately 200 kilometers southwest of Kodiak (Muench and Schumacher, 1980). Long-term mean northward geostrophic transport is 0.6 million cubic meters per second (Reed and Bograd, 1995). However, the mean flow is variable, with large changes over a few months, weeks, and days. The mean flow variability correlates to freshwater discharge and longshore winds (Schumacher, Stabeno, and Roach, 1989). Observed flow speeds generally are 20-70 centimeters per second in winter and 5-15 centimeters per second in summer (Schumacher, Stabeno, and Roach, 1989).

Southern and central Shelikof Strait has depths greater than 200 meters and an estuarine-like circulation (Reed, Schumacher, and Incze, 1987). Bottom temperature and salinity variations seem to result from an intrusion of slope water that moves northward over the strait's southern sill (Reed, Schumacher, and Incze, 1987; Reed and Schumacher, 1989a,b). Southern deepwater sources result from the southern water vertically mixing (Reed, Schumacher, and Incze, 1987).

III.A.3.b(2) Tides

In Shelikof Strait, the tide floods from both ends of the strait; the ebb is out the southwest end. The mean tidal range in Shelikof Strait is 2.1-3.7 meters (7-12 feet) (Figure III.A-6).

III.A.3.b(3) Upwelling, Downwelling, Fronts, and Convergences

Strickland and Sibley (1984) showed that downwelling is clearly indicated in the Shelikof Strait area in winter, with weak upwelling during the summer. A convergence band wraps around Cape Douglas and extends down northern and western Shelikof Strait due to freshwater outflow from Cook Inlet (Galt, Lehr, and Payton, 1991).

III.A.3.b(4) Sea Ice

Other than localized freezing in protected bays during particularly cold periods, sea-ice formation in Shelikof Strait has not been observed.

III.A.3.b(5) Temperature

Surface temperatures reach a minimum in March and a maximum in August. There is no seasonal change for subsurface temperatures (Reed and Schumacher, 1989a,b). In Shelikof Strait, the surface water along the peninsula side is colder than water near Kodiak Island due to the discharge from lower Cook Inlet (Kim, 1986). Waters in the central Shelikof Strait have similar temperatures to waters in Kennedy Entrance (approximately 5 °Celsius in March) (Kim, 1986). Warmer water, greater than 5 °Celsius, occupies deeper portions of the strait between Kodiak Island and the Alaska Peninsula (Kim, 1986).

III.A.4. Water Quality

This section presents revised and updated information from the lower Cook Inlet Planning Area Oil and Gas Lease Sale 149 final EIS (USDOI, MMS, Alaska OCS Region, 1995), hereby incorporated by reference.

The quality of the Cook Inlet aquatic environment is determined by water's physical (described in Section III.A.3 – Oceanography) and chemical characteristics. Naturally occurring and contaminant substances enter Cook Inlet waters and are diluted and dispersed by the currents associated with the tides, estuarine circulation, wind-driven waves and currents, and Coriolis force (Section III.A.3). Based on standard salt balance calculations, 90% of waterborne contaminants would be flushed from the inlet in 10 months (Kinney, Button, and Schell, 1969, 1970). Because tidal turbulence is the major mixing factor in Cook Inlet, rather than seasonally varying freshwater input, this flushing rate is relatively seasonally invariant. However, some of the persistent contaminants may accumulate in (1) the food chain and exceed toxic thresholds, particularly in predators near the top of the food chain, or (2) the seafloor sediments.

Units of concentration and mass used in this section have been converted from multiple, original metric or English formats to a limited set of consistent units. Chemical concentrations are reported in fractional units such as parts per million, avoiding both English and metric units. Mass is given in [metric] "tonnes." For reference, metric tonnes are about equal to English long tons, and both are 10% greater than English short tons.

III.A.4.a. Sources

The constituents of the waters mainly are composed of naturally occurring substances but also include manmade substances—contaminants. The naturally occurring substances are derived from the atmospheric, terrestrial, and other aquatic (fresh and marine) environments. The waterborne and airborne substances entering Cook Inlet waters also may include contaminants.

III.A.4.a(1) Stream Discharges and Marine Water Input

The mean annual volume of freshwater discharged by streams flowing into Cook Inlet exceeds 70 billion cubic meters (Table III.A-1); this volume probably is low because the discharge rates of a number of streams, particularly along the western side of Cook Inlet, have not been measured. About 80% of this discharge is supplied by the Knik, Matanuska, and Susitna rivers. In general, discharge rates are low in November through March; begin to rise in April; peak in June, July, or August; and decline in September and October. For the Knik, Matanuska, and Susitna rivers, the mean monthly discharge rates in November through March range from about 2-9% of the peak discharge rates in June or July (Freethey and Scully, 1980).

As noted in Section III.A.3, marine water (a mixture of seawater, glacier meltwater, and freshwater runoff) from the Alaska Coastal Current enters Cook Inlet through the Kennedy and Stevenson entrances. Long-term mean northward geostrophic transport through Shelikof Strait is 0.6 million cubic meters per second (Reed and Bograd, 1995). In response to the general counterclockwise circulation, only part of the water from the Alaska Coastal Current would flow northward along the eastern side of lower Cook Inlet before crossing the inlet and flowing southward into Shelikof Strait. In Kennedy Entrance, the southern part of lower Cook Inlet, and the northern part of Shelikof Strait, the mean transport for March and October of 1985 was 0.14 million and 0.27 million cubic meters per second, respectively (Reed, Schumacher, and Incze, 1987). As these volumes are near the low end of the average noted above and during the times of the year when freshwater input to the marine environment is low, it is assumed they represent a possible volume range of Alaska Coastal Current water that circulates in lower Cook Inlet. Rates of 0.14 million and 0.27 million cubic meters per second would transport about 63-120 times the annual freshwater discharge (2,223 cubic meters per second; see Table III.A-1) entering Cook Inlet.

III.A.4.a(2) Suspended Particulate Matter

Many of the streams flowing into Cook Inlet are glacial fed and contain high concentrations of suspended particulate matter (Table III.A-1). An estimated 99% of the annual suspended-particulate matter load is carried by the streams during the period from May through October (Parks and Madison, 1985). About 80%-90% of the 70 million tonnes of sediment deposited in lower Cook Inlet and Shelikof Strait is derived from suspended-particulate matter in river flows, primarily from the Knik, Matanuska, and Susitna rivers (Feely and Massoth, 1982; Trefry, 2000; Boehm, 2001a).

III.A.4.a(3) Contaminants

The principal sources of contaminants entering the marine environment include:

- discharges from municipal wastewater-treatment systems;
- discharges from industrial activities that do not enter municipal wastewater systems (petroleum industry and seafood processing);
- runoff from urban, agricultural, and mining areas; and
- accidental spills or discharges of crude or refined petroleum and other substances.

Contaminants may be classified as chemical, physical, or biological (Krenkel, 1987), as described in the following.

The chemical contaminants include organic and inorganic substances. The decomposition of organic substances uses oxygen and, if enough organics are present, the concentration of oxygen could be reduced to levels that would threaten or harm oxygen-using inhabitants of the water column. The measure of oxygen-depleting substances is the biochemical oxygen demand. Some of the organic substances, such as oil (crude or refined), can have a wide variety of sublethal and lethal effects on marine organisms; these effects can impair subsistence, recreational, or commercial uses of the marine biological resources. The discharge of soluble inorganic substances may change the pH or the concentration of trace metals in the water, and these changes may be toxic to some marine plants and animals.

Physical contaminants include suspended solids, foam, and radioactive substances. Suspended solids may inhibit photosynthesis, decrease benthic activity, and interfere with fish respiration. Foam results from surface-active agents and may cause a reduction in the rate of oxygen-gas transfer from the atmosphere into the water. Radioactivity may come from natural sources, fallout, or waste discharges and can be dissolved in the water or incorporated into the biota.

Biological contamination may cause (1) waterborne diseases by adding viruses, protozoa, or bacteria to the receiving waters or (2) excessive biological growth (i.e., eutrophication) by increasing the concentration of nutrients, nitrogen, and/or phosphorus in the water; eutrophication also occurs naturally. The presence of coliform bacteria in the water is considered an indication of fecal contamination.

III.A.4.a(3)(a) Natural or Nonpoint Sources of Contaminants

Many contaminants in Cook Inlet waters are derived from natural (or nonpoint) sources. Nonpoint sources of water pollution also are multiple, diffuse sources of pollution (Environmental Protection Agency, 1990). Primary nonpoint sources of pollution include runoff from urban areas and communities, farms, and mining areas.

III.A.4.a(3)(a)1) Hydrocarbons

Natural sources of hydrocarbons in Cook Inlet include terrestrial and marine plants and animals, coal, forest fire soot, oil seeps, and eroded (petroleum) source rock. Terrestrial bacteria and plants and marine bacteria, phytoplankton, and zooplankton produce a variety of organic compounds that includes the lipids (oils), fats, waxes, terpenes (Button, 1984; Button and Jüttner, 1989), and hydrocarbons. Most of the hydrocarbons detected in the waters, suspended-particulate matter, seafloor sediments, and intertidal biota of Cook Inlet in studies since oil development started in Cook Inlet are of recent biogenic origin (Shaw, 1981; Katz and Cline, 1981; Kaplan et al., 1980; Venkatesan and Kaplan, 1982). Pyrogenic polycyclic aromatic hydrocarbons (formed by incomplete burning) enter Cook Inlet through deposition of soot from combustion of fuel and natural organic matter, particularly from forest fires (Kaplan et al., 1980; Venkatesan and Kaplan, 1982; Boehm, 1998). Atmospheric transport can carry combustion polycyclic aromatic hydrocarbons long distances before deposition; thus, their presence is expected with or without local sources. Pyrogenic polycyclic aromatic hydrocarbons also enter the marine environment when creosote or coal tar products are used to protect wood pilings and docks (Page et al., 1993).

III.A.4.a(3)(a)1)a) Rivers

The streams and rivers draining into Cook Inlet carry hydrocarbons. Part of these carbon compounds are biogenic, and part comes from the erosion of sedimentary rocks that may contain hydrocarbon compounds, from coal deposits found throughout the Cook Inlet region, and from peat (Shaw and Wiggs, 1980; Page et al., 1995; Short et al., 1999, 2000; Boehm et al., 2000; Boehm 2001a; Lees et al., 2002; Mudge, 2002). In all sedimentary rocks, about 3% of the organic matter is converted to hydrocarbons with 15 or more carbon atoms and practically all shales and carbonate rocks contain liquid hydrocarbons that are comparable to reservoir oils (Hunt, 1979). Coal contains substances derived from plant resins, waxes, and fats and oils and includes aliphatic and aromatic compounds (Schobert, 1990). Peat from Cook Inlet and elsewhere contains significant quantities of specific polycyclic aromatic hydrocarbons: naphthalenes and perylene (Lees et al., 2002; Boehm, 2001b, Steinhauer and Boehm, 1992). It is not clear why naphthalenes accumulate in peat, but perylene accumulates as a natural degradation product of organic matter decomposition. The amount of carbon streams and rivers transport into Cook Inlet is estimated to be at least 35,000 tonnes per year. This is a low-range estimate, because it is based on the amount of dissolved carbon in the Susitna River (at Gold Creek) in June, July, and August of 1985 (Still et al., 1985); this amount is assumed to be 4 parts per million.

III.A.4.a(3)(a)1)b) Coal

Cook Inlet is part of the Cook Inlet-Susitna coal province that includes the Susitna and Matanuska Valleys, the western side of the Kenai Peninsula, and Cook Inlet north of Augustine Island (State of Alaska, Dept. of Natural Resources, 1990). Coal particles are transported to the Cook Inlet marine environment as the result of local erosion, river transport, and possibly coastal marine transport from Gulf of Alaska sources (Lees et al., 2002; Short and Heintz, 1998; Short et al., 1999). Coal hydrocarbons have been found in both Cook Inlet sediments and biota (Shaw and Wiggs, 1980; Boehm, 2001a; Lees et al., 2002).

III.A.4.a(3)(a)1)c) Seeps

Oil seeps also are a source of hydrocarbons to Cook Inlet. The Gulf of Alaska has high potential for oil seepage, and Cook Inlet has medium potential for oil seepage (Becker and Manen, 1988). Seeps have been identified upcurrent to Cook Inlet in the Katalla area, in the Cook Inlet watershed, and on the Alaska Peninsula (Blasko, 1976; Becker and Manen, 1988; Page et al., 1995). Becker and Manen identified eight seeps in the Cook Inlet and Shelikof Strait areas: Iniskin Peninsula (Oil Bay), Chinitna Bay, Tyonek and the Mouth of the Little Susitna River, Anchorage near Knik Arm (no longer active), Puale Bay (Coal Bay, Wide Bay, and Oil Creek), Shelikof Strait, Douglas River, and Bruin Bay.

III.A.4.a(3)(a)1d) Source Rock

Eroded petroleum source rock also is a significant natural source hydrocarbon in the Gulf of Alaska (Boehm et al., 2000). Some of the source rock hydrocarbons are carried as suspended sediments north into and along the east side of Cook Inlet by the coastal current.

III.A.4.a(3)(a)1e) Vessels

For this analysis, oil pollution from commercial and recreational vessels is considered a nonpoint source of pollution because of the dispersed character of the sources. Between 1965 and 1980, there were a reported 269 nonpetroleum-industry oil spills; the reported amount of oil spilled for 206 of the spills was 22,746 barrels—no volume was reported for 63 spills (State of Alaska, Oil and Gas Conservation Commission [OGCC], 1981). (Nonpetroleum-industry spills included spills from fishing boats, vessels carrying refined products to communities, and other vessels.)

III.A.4.a(3)(a)2) Metals

A variety of metals enters Cook Inlet in the stream discharges. Tables III.A-2 and III.A-3 show the concentrations of some of the riverine metals entering Cook Inlet region and the resulting metal loading to Cook Inlet.

The elemental composition of suspended-particulate matter from the mouths of the Susitna, Matanuska, and Knik rivers is summarized in Table III.A-2, and the composition of suspended-particulate matter in Cook Inlet is summarized in Table III.A-4. Table III.A-2 also shows the abundance of the elements in the earth's crust. The suspended-particulate matter discharged by the rivers into Cook Inlet is derived from the erosion of a variety of igneous, sedimentary, and metamorphic rocks surrounding the inlet. Aluminum, calcium, iron, and magnesium are present in relatively high concentrations (greater than 1% by weight or greater than 10,000 parts per million by weight = 10,000 micrograms per gram dry weight sediment); manganese occurs in intermediate concentrations on the order of a thousand parts per million. The other metals are found in what is called "trace" amounts. Feely et al. (1981) note that within the statistical limits of the measurements, the samples from the lower Cook Inlet have very nearly the same major elemental composition as do the samples from the rivers. However, the composition of suspended-particulate matter in the southeastern part of Cook Inlet (the outer part of Kachemak Bay and the Kennedy and Stevenson entrances) indicates these particles principally came from the Copper River (Feely et al., 1981) and were transported westward by the Alaska Coastal Current. This is consistent with the circulation of Alaska Coastal Current water into Cook Inlet discussed in Section III.A.3.

Estimates of the amount of zinc, barium, mercury, cadmium, and carbon that might be discharged into Cook Inlet probably are at the low end of a possible range. The estimates are based on values at Gold Creek along the Susitna River. As noted in Table III.A-1, the mean annual discharge of the Susitna River (at Gold Creek) is 282 cubic meters per second; this amount is about 13% of the total mean annual discharge of the streams and rivers listed in that table.

III.A.4.a(3)(b) Regulatory Control of Contaminants

The principal method for controlling pollutant discharges is through Section 402 (33 United States Code [U.S.C.] § 1342) of the Federal Water Pollution Control Act (commonly referred to as the Clean Water Act) of 1972, which establishes a National Pollution Discharge Elimination System (NPDES) (Laws, 1987). Under Section 402, the Environmental Protection Agency or authorized states can issue permits for pollutant discharges, or they can refuse to issue such permits if the discharge would create conditions that violate the water-quality standards developed under Section 303 (33 U.S.C. § 1313) of the Clean Water Act. The Clean Water Act, Section 403 (33 U.S.C. § 1343), states that no NPDES permit shall be issued for a discharge into marine waters except in compliance with established guidelines.

The guidelines require a determination that the permitted discharge will not cause unreasonable degradation to the marine environment (40 Code of Federal Regulations [CFR] 125.122). Unreasonable degradation of the marine environment means (1) significant adverse changes in ecosystem diversity, productivity, and stability of the biological community within the area of discharge and surrounding biological communities; (2) threat to human health through direct exposure to contaminants or through consumption of exposed aquatic organisms; or (3) loss of aesthetic, recreational, scientific, or economic values, which is unreasonable in relation to the benefit derived from the discharge.

III.A.4.a(3)(c) Point Sources of Contaminants

The principal point sources of contaminants in Cook Inlet are the discharges from municipalities, seafood processors, and the petroleum industry.

III.A.4.a(3)(c)1) Municipalities

There are 10 communities in the Cook Inlet area discharging treated municipal wastewaters into Cook Inlet or into waters connected to or flowing into the inlet (Table III.A-5). Wastewater entering the plants may contain a variety of organic and inorganic contaminants, metals, nutrients, sediments, and bacteria and viruses. The wastewaters of (1) Anchorage (Point Woronzof Wastewater Treatment Facility), English Bay, Port Graham, Seldovia, and Tyonek receive only primary treatment and (2) Eagle River, Girdwood, Homer, Kenai, and Palmer receive secondary treatment. The maximum permitted wastewater discharge for (1) Anchorage is 167 thousand cubic meters per day and (2) the other communities is a range from 38-6,100 cubic meters per day.

For Anchorage, the monthly average of the daily discharge of biochemical oxygen demand and total suspended solids in the wastewater is not to exceed 21,762 kilograms per day and 18,137 kilograms per day, respectively (Table III.A-5). For the other communities, the maximum permitted discharges for biochemical oxygen demand and total suspended solids are less than 161 kilograms per day and 241 kilograms per day, respectively (Table III.A-5). Based on daily maximum permitted discharges, the communities could release about 7.42 million kilograms of biochemical oxygen demand and 6.27 million kilograms of suspended solids into Cook Inlet annually. The amount of hydrocarbons discharged with municipal wastewater, based on worldwide estimates, may be significant (National Research Council, 1985).

A summary of effluent-monitoring data for Anchorage Water and Wastewater Utility Point Woronzof Wastewater Treatment Facility is shown in Table III.A-6. For 1993, the effluent-discharge rate averaged 110,000 cubic meters per day; the biochemical oxygen demand averaged about 11,700 kilograms per day (4,270 tonnes/year); and the total suspended solids averaged about 5,560 kilograms per day (2,030 tonnes/year). The discharged average amount of zinc was about 8 kilograms per day (about 2.9 tonnes/year) and mercury was about 0.05 kilograms per day (about 0.02 tonnes per year). Oil and grease discharges averaged about 2,430 kilograms per day (about 890 tonnes/year). Oil and grease analysis measures the amount of substances soluble in trichlorotrifluoroethane and includes thousands of organic compounds with varying physical, chemical, and toxicological properties.

The other communities bordering Cook Inlet and Shelikof Strait use septic tanks or other individual systems to treat domestic and commercial wastewaters.

The metals that occur in the permitted discharges the Municipality of Anchorage Point Woronzof Wastewater Treatment Facility (and other Cook Inlet wastewater facilities) also occur in drilling muds, cuttings, and produced waters from offshore oil and gas industry operations in State waters. Table III.A-3 does not include drill cuttings, even though they are discharged at twice the rate of drilling mud because their trace metal composition is similar to the natural background (Boehm, 1998). Except for nontoxic barium, a primary constituent of drilling mud, wastewater discharges contribute more metals to Cook Inlet than oil industry does. However, trace-metal loadings from both oil industry and wastewater anthropogenic sources together are a small fraction of that from natural sources in Cook Inlet.

III.A.4.a(3)(c)2) Seafood Processors

The commercial-fishing industry in the Cook Inlet area harvests a variety of finfishes and shellfishes that include salmon (king, red, coho, pink, and chum), herring, halibut, crab, shrimp, and various other species (Table III.A-7). Most of the commercial harvesting of the fishery resources generally occurs between April and October.

The fisheries harvests are processed at various onshore and offshore facilities to produce a variety of products that include fresh, frozen, and canned meat and roe (eggs from herring and salmon). The capacities of the various processing facilities range from less than 500 kilograms to several thousand tonnes per day. The number of onshore and offshore processors operating in the area varies with the species being harvested and from year to year. Many of the onshore processors are located in the tidal estuaries of rivers or in bays or inlets. The location of the offshore processors depends on the resources and where they are being harvested.

Processing of the commercial-fish harvests generates wastes that usually are discharged into the waters adjacent to the onshore plant or into the waters in which the offshore processors are operating. Estimates of the amount of waste generated during processing depends on the type of resource being processed (Table III.A-7). Assuming all the salmon, herring, and crab caught in Cook Inlet are processed in facilities located onshore or offshore in the area and based on the landings of halibut in Homer and Kenai, the amount of seafood wastes generated during the "fishing season" from these fisheries might range from about 2.52-8.58 million kilograms (2.52-8.58 thousand tonnes) of organic matter (Table III.A.-7).

III.A.4.a(3)(c)3) Petroleum Industry:

The activities associated with petroleum exploitation that are most likely to affect water quality in the Cook Inlet sale area are (1) the permitted discharges from exploration-drilling units and production platforms and (2) petrochemical-plant operations. Into 2002, there were 15 oil-production platforms and 1 gas-production platform operating in upper Cook Inlet (Table III.A-8). In addition, there were three production-treatment facilities located onshore; produced waters from 10 of the oil-production platforms are treated at these facilities. (In 1992, three oil-production platforms and one production-treatment facility were shut down.) In 2000, the oil-production platforms produced about 9 million barrels of oil and 47 million barrels of produced water (State of Alaska, OGCC, 2001).

III.A.4.a(3)(c)3)a) Exploration and Production Discharges

Petroleum-production operations in upper Cook Inlet discharge a large volume of water and a variety of chemicals used to conduct the various operations associated with petroleum exploration and production.

The characteristics of the produced waters, as well as other discharges—except drilling muds and cuttings—described in this section are based on information obtained during the Cook Inlet Discharge Monitoring Study that, basically, was conducted between April 10, 1988, and April 10, 1989 (EBASCO Environmental, 1990a,b). The monitoring program used to develop the current general NPDES permit for oil and gas exploration, development, and production facilities in Cook Inlet AKG285000 (Environmental Protection Agency, 1999).

III.A.4.a(3)(c)3)b) Produced Waters

From the 1960's to the end of 2001, approximately 1,030 million barrels of oil and 978 million barrels of water were produced principally from four offshore oil fields in upper Cook Inlet (State of Alaska, OGCC, 2002). Peak production from these fields occurred in 1970 when about 70 million barrels of oil were produced. At the end of 1975, about 514 million barrels of oil and 61 million barrels of water had been produced (State of Alaska, Department of Natural Resources, 1969, 1970, 1971, 1972, 1973, 1974, 1975).—about 50% of the total amount of oil and 6% of the total amount of water produced from the offshore platforms through 2001 (State of Alaska, OGCC, 2002).

Produced waters constitute the largest source of naturally occurring and manmade substances discharged into the waters. These waters are part of the oil/gas/water mixture produced from the wells and contain a variety of substances dissolved from the geologic formation through which they migrated and in which they became trapped. These can include small quantities of naturally occurring radioactive materials (NORM), although concentrations from freshwater formations such as occur in Cook Inlet are usually low. In addition, chemicals are added to the fluids that are part of various activities including water flooding; well work over, completion, and treatment; and the oil/water separation process. These chemicals might include flocculants, oxygen scavengers, biocides, cleansers, and scale and corrosion inhibitors; during the 1987-1988 Cook Inlet Discharge Monitoring Study (Envirosphere Company, 1987; EBASCO Environmental, 1990a,b) of production platforms, the types of chemicals added during the various operations ranged from less than 4 to 410 liters per day per platform. The discharge of produced waters is of concern because of the types and amounts of naturally occurring substances they may carry and manmade substances that may be added.

Before discharging into the waters of Cook Inlet, the produced waters pass through separators to remove oil and gas from the waters. The treatment process removes suspended oil particles from the waters, but the effluent contains dissolved hydrocarbons or those held in colloidal suspension (Neff and Douglas, 1994). Relative to the crude oil, the treated produced waters are enriched in the more soluble low-molecular weight saturated and aromatic hydrocarbons. As specified in the NPDES permit, the maximum daily discharge limitation of oil and grease in the produced waters discharged into the inlet is 72 parts per million, and the monthly average is 48 parts per million.

Some of the characteristics of the produced waters that were discharged into Cook Inlet during the Cook Inlet Discharge Monitoring Study are shown and described in Tables III.A-9 and III.A-10. The amount of oil and grease, biochemical oxygen demand, and zinc in the discharges associated with petroleum production in Cook Inlet is shown in Table III.A-11; this information is based on concentrations shown in Table III.A-9 and produced water discharge rates in Table III.A-8. The biochemical oxygen demand averaged about 10,000 kilograms per day (about 3,662 tonnes/year). The discharges included about 0.9 kilograms of zinc per day (about 0.31 tonnes per year). The amount of oil and grease discharged is about 694 kilograms per day (about 253 tonnes/year); this is about 75% of the monthly average specified in the National Pollution Discharge Elimination System permit. As noted in Section III.A.4.a(3)(c)1) and Table III.A-6, the Municipality of Anchorage Point Woronzof Wastewater Treatment Facility discharges about 11,670 kilograms of biochemical oxygen demand, 8 kilograms of zinc, and 2,430 kilograms of oil and grease daily.) As shown in the Cook Inlet Discharge Monitoring Study (EBASCO Environmental, 1990a) for oil production, the produced waters discharged into Cook Inlet contain a variety of hydrocarbons that include benzene (2.280 to 30.200 parts per million), toluene (1.050- 15.800 parts per million), phenol (0.0005-3.6800 parts per million), naphthalene (0.0025-6.500 parts per million), fluorene (0.0050-0.118 parts per million), pyrene (0.005-1.240 parts per million), and chrysene (0.0050-0.0500 parts per million).

During the Cook Inlet Discharge Monitoring Study, the toxicity of the produced waters was determined by using a standard 96-hour static acute toxicity test (96-hour LC_{50}) to the marine invertebrate *Mysidopsis bahia* (EBASCO Environmental, 1990a). The toxicities of the produced waters ranged from 0.27% to 82.47% of the effluent (EBASCO Environmental, 1990a); these concentrations equal 2,700 to 824,700 parts per million. The classification of relative toxicity of chemicals to marine organisms proposed by the IMCO/FAO/UNESCO/WHO, reported in Neff (1991), provides a system for assessing relative toxicities. Concentrations less than 1 parts per million (or parts per million) are very toxic; 1 to 100 parts per million are toxic; 100 to 1,000 parts per million are moderately toxic, 1,000 to 10,000 parts per million are slightly toxic, and greater than 10,000 parts per million are practically nontoxic. (Toxicity is the inverse of the LC_{50}; so as the LC_{50} value increases, the toxicity associated with the substance decreases. For example, a substance with an LC_{50} of 1,000,000 parts per million is less toxic than a substance with an LC_{50} of 3,000 parts per million.) The produced waters sampled in the monitoring study would range in toxicity from slightly toxic to practically nontoxic.

III.A.4.a(3)(c)3)c) Drilling Muds and Cuttings

The general NPDES permit authorizes the discharge of only approved generic drilling muds and additives. Drilling muds consist of water and a variety of additives (Table III.A-12); 75% to 85% of the volume of most drilling muds currently used in Cook Inlet is water (Neff, 1991).

When released into the water column, the drilling muds and cuttings discharges tend to separate into upper and lower plumes (Menzie, 1982). The discharge of drilling muds at surface ensures dispersion and limits the duration and amount of exposure to organisms (National Research Council, 1983). Most of the solids in the discharge, greater than 90%, descend rapidly to the seafloor in the lower plume. The seafloor area in which the discharged materials are deposited depends on the water depth, currents, and material particle size and density (National Research Council, 1983). In most OCS areas, the particles are deposited within 150 meters below the discharge site; however in Cook Inlet, which is considered a high-energy environment, the particles are deposited in an area that is greater than 150 meters below the discharge site (National Research Council, 1983). The physical disturbance of the seafloor caused by the deposition of drilling discharges may be similar to that caused by storms, dredging, disposal of dredged material, or certain types of fishing activities (National Research Council, 1983). The upper plume contains the solids and water-soluble components that separate from the material of the lower plume and are kept in suspension by turbulence. Dilution rates as high as 1,000,000:1 may occur for drilling solids within a distance to 200 meters of a platform with surface currents of 30-35 centimeters per second (about 0.6-0.7 knots) (National Research Council, 1983).

Between 1962 and 1994, there were about 546 wells drilled in Cook Inlet (USDOI, MMS, Alaska OCS Region, 1995). One Continental Offshore Stratigraphic Test (COST) Well and 11 exploration wells were drilled in Federal waters and 75 exploration and 459 development and service wells were drilled in State waters—mainly in upper Cook Inlet. From 1962 through 1970, 292 wells were drilled (62 exploration and 230 development and service). From 1971 through 1993, the number of wells drilled per year has ranged from 3-20; the average number drilled per year is about 11.

For the Cook Inlet Sale 191 area, we estimate the (1) average exploration well will use about 140 tonnes of dry mud and produce approximately 400 tonnes of rock cuttings and (2) average development or service well will use approximately 70 tonnes of dry mud and produce about 500 tonnes of cuttings. Table III.A-13 shows estimates of the amounts of drilling muds (125,120 tonnes) and cuttings (268,900 tonnes) discharged into Cook Inlet between 1962 and 1993. The yearly discharge based on drilling 11 wells per year is estimated to be about 3,690 tonnes of drilling muds and 5,590 tonnes of cuttings. The amount of suspended sediments is estimated to be 10% of the discharge, or 928 tonnes. Drilling muds and cuttings characteristics; i.e., composition and specialty additives, were summarized in Appendix J of USDOI, MMS, Alaska OCS Region, 1995.

The amount of barite (barium sulphate—$BaSO_4$) in the drilling muds is estimated to be about 63% (Table III.A-12). Barium makes up about 59% of barite or about 37% of the drilling mud. The amount of barium that might have been discharged into Cook Inlet between 1962 and 1993 is estimated to be about 46,200 tonnes. For a single well discharging 330 tonnes of drilling muds, the amount of barium discharged is estimated to be about 122 tonnes. The Environmental Protection Agency limits on the amount of mercury and cadmium in the barite is 1 part per million mercury and 3 parts per million cadmium (dry weight); these limits are assumed to be the concentration of mercury and cadmium in the discharged drilling muds. The amount of mercury and cadmium discharge per well (based on 330 tonnes of muds per well) is estimated to be 0.12 kilograms and 0.36 kilograms, respectively. The toxicity (96-hour LC_{50}) of the muds used to drill 39 production wells in Cook Inlet between August 1987 and February 1991 ranged from 1,955 to greater than 1,000,000 parts per million for a marine shrimp (Alaska Oil and Gas Assoc., 1991; Neff, 1991). The percentages of the wells with toxicities (1) greater than 100,000 parts per million was 79%, (2) between 10,000 and 100,000 was 10%, and (3) between 1,000 and 10,000 was 10%; concentrations greater than 10,000 are practically nontoxic and between 1,000 and 10,000 are slightly toxic. The toxicity of the COST well drilling-fluid discharges ranged from (1) 32,000 to 150,000 parts per million for shrimp, (2) 0.3-2.9% (3,000-29,000 parts per million) for pink salmon fry, (3) greater than 70,000 to greater than 200,000 parts per million for amphipods, and (4) 10,000-125,000 parts per million for mysids. Thus, most COST well drilling-fluid discharges were practically nontoxic for a variety of marine organisms.

III.A.4.a(3)(c)3)d) Other Discharges

The characteristics of some of the other permitted discharges associated with oil- and gas-production activities in State of Alaska waters of Cook Inlet are described in the Summary Reports of the Cook Inlet Monitoring Study (Envirosphere Company, 1987, 1989a-d; EBASCO Environmental, 1990a) and summarized in the Comprehensive Report (EBASCO Environmental, 1990b). As noted in these reports, seawater is the principal component of most of the discharges; in some cases it is the only constituent. Also, there is a wide range of concentrations of the various additives in the discharges; the rate of adding compounds to the discharge ranges from less than 4 to hundreds of liters per month, while the discharge rates of the various effluents might range from 0 (for intermittent discharges) to tens of cubic meters per day, or more. The produced water-treatment additives include biocides, scale inhibitors, emulsion breakers, and corrosion inhibitors. The range of maximum concentrations and toxicities (96-hour LC_{50}) for the (1) biocides is about 5-640 parts per million and slightly to very toxic, respectively; (2) scale inhibitors is about 30-160 parts per million and practically nontoxic to moderately toxic, respectively; (3) emulsion breakers is about 10 parts per million and toxic, respectively; and (4) corrosion inhibitors is about 20-160 parts per million and toxic, respectively (Neff, 1991).

III.A.4.a(3)(c)4) Petrochemical Plants

The petroleum-processing plants located in Cook Inlet are shown in Table III.A-8. The monthly average discharge limitation for (1) the Tesoro Refinery includes biochemical oxygen demand at 92.5 kilograms per day, chemical oxygen demand at 599 kilograms per day, and total suspended solids of 75.43 kilograms per day, and (2) Union Chemical included ammonia as N (nitrogen) of 873 kilograms per day and organic nitrogen (as N) of 1,349 kilograms per day (Table III.A-14). An additional, Chevron Refinery ceased operations in September 1991.

III.A.4.a(3)(c)5) Summary of Point-Source Discharges

Estimates of the annual suspended solids discharged from the municipalities (2.03 thousand tonnes), refinery (0.03 thousand tonnes), and drilling muds and cuttings (0.93 thousand tonnes) are only a fraction of the suspended sediments (36,343 thousand tonnes) discharged by the Knik, Matanuska, and Susitna Rivers (Table III.A-15). Estimates of the annual discharge of biochemical oxygen demand or organic wastes from municipalities (4.27 thousand tonnes), seafood processors (2.52-8.58 thousand tonnes), and produced waters (3.67 thousand tonnes) are all about the same order of magnitude. Estimates of discharge of several metals in municipal discharges, drilling muds, and produced waters were provided in Table III.A-3. For all metals reported, the anthropogenic inputs are small compared to river input.

III.A.4.a(3)(d) Oil Spills

Oil spills have occurred in Cook Inlet, and these spills and the risk of future spills are an issue of major concern. This section summarizes more detailed information given in Appendix A.

III.A.4.a(3)(d)1) Historical Crude Oil Spills Greater Than or Equal to 1,000 Barrels in Cook Inlet

This section presents the available information on Cook Inlet crude oil spills from pipelines or platform facilities. The oil spill records are not complete for the entire production period of Cook Inlet (1957 to present); however, this section summarizes information about the nature of oil spills from production facilities and pipelines in Cook Inlet; see Appendix A for sources and detail.

III.A.4.a(3)(d)2) Historical Crude and Refined Oil Spills Greater Than or Equal to 1,000 Barrels from Pipelines

Three pipeline spills greater than or equal to 1,000 barrels have been identified from Cook Inlet databases. They are shown as follows:

Year of Spill	Company Platform	Size of Spill	Cause of Spill
1966	Shell Platform A	1,400 barrels	Pipe Rupture
1967	Shell Platform B	1,400 barrels	Pipe Rupture
1968	Shell Platform B	1,000 barrels	Pipe Rupture

III.A.4.a(3)(d)3) Historical Crude and Refined Oil Spills Greater Than or Equal to 1,000 Barrels from Tankers and Motor Vessels

This section presents the available information on Cook Inlet crude- and refined-oil spills from tankers, motor vessels, or other known sources. The oil-spill records are not complete for the entire period of Cook Inlet recorded marine transportation spills (1949 to present); however, this section provides some information about the nature of oil spills from tankers, motor vessels, or other sources in Cook Inlet. The information was compiled from the sources listed in Appendix A.

Year	Name	Location	Type	Barrels
1966	*Tanker Vessel*	Nikiski	Diesel	2,000
1966	*Tanker Vessel*	Nikiski Dock	Oil	1,000
1967	*Washington Trader*	Drift River Terminal	Crude Oil	1,700
1976	*Sealift Pacific*	Nikiski	JP-4	9,420
1984	*Cepheus*	Near Anchorage	Jet A	4,286
1987	*Glacier Bay*	Near Kenai	Crude Oil	3,095
1989	*Lorna B*	Nikiski	Diesel	1,547-1,714

In addition to the tanker spills, there are at least two documented spills from outside the Cook Inlet area that have drifted into Cook Inlet. The first spill is from an unidentified source documented by the Federal Water Pollution Control Administration (1970). The suspected source of the spill was from some tank vessel dumping ballast and slop at sea, which used to be a common practice. No oil-spill volume was provided in the spill report. Based on the estimated number of dead birds and the length of coastline oiled, we estimate this spill was greater than or equal to 1,000 barrels. This spill impacted lower Cook Inlet, including the Barren Islands, Kodiak Island, and Shelikof Strait. The second documented tanker spill is the *Exxon Valdez*. This spill drifted into lower Cook Inlet. It is estimated that approximately 1-2% of the spill entered lower Cook Inlet reaching as far north as Anchor Point.

III.A.4.a(3)(d)3) Historical Crude-Oil Spills Greater Than or Equal to 1,000 Barrels from Blowouts

The record for Cook Inlet blowouts is not validated but is presented as the best available information based on newspaper accounts. No oil spills due to blowouts were identified in either the spill data or the newspaper accounts. A minimum and perhaps a maximum of three natural gas blowouts occurred in Cook Inlet. The following identifies the three gas blowouts:

The Pan American blowout occurred during drilling on August 1962 from the Cook Inlet State No. 1 well. The well encountered natural gas and blew gas from August 23, 1962, to October 23, 1963. Pan American Petroleum Corporation drilled a relief well, No. 1-A, to stop the blowout.

A short-term natural gas blowout occurred at the Grayling Platform in May 1985. Union Oil Company was drilling well G-10RD into the McArthur River Field when the blowout occurred. The event lasted from May 23 to May 26. The platform was evacuated, and observers noted a plume of gas, water, and mud reaching a height of 600 feet above sea level. Union prepared to drill a relief well, but the blowout stopped on its own because of bridging. Bridging seals off the escaping fluids and gases when part of the formation around the well bore collapses into the well bore and naturally closes it. The operator regained permanent well control by pumping cement through the drill pipe in G-10RD. There was no fire or injuries, and personnel shut in all oil wells prior to evacuating the platform.

The last blowout in Cook Inlet occurred at the Steelhead Platform from well M-26 on December 20, 1987. Marathon Oil Company was drilling into the McArthur River Field. The gas blowout lasted from December 20, 1987, until December 28, 1987. A relief well was started, but the blowout bridged before the relief well was completed. The well blew out natural gas, water, coal, and rocks. The escaping gas caught fire, which damaged the deck of the platform.

III.A.4.a(3)(d)4) Historical Small Oil Spills

Small spills are spills that are less than 1,000 barrels. The reported amount of oil spilled in Cook Inlet waters from 1965 through 1975 was 20,636 barrels; between 1976 and the end of 1979 an additional 9,534 barrels were reported spilled (State of Alaska, OGCC, 1981). Of total hydrocarbons spilled between 1965 and 1979, the aforementioned large spills (greater or equal to 1,000 barrels) can account for 17,920 barrels out of 30,170, or 59% of the total spillage. Clean data have not been published for Cook Inlet spilled **oil** volumes in more recent decades.

The spill rate for the offshore oil and gas production industry in Cook Inlet is approximately 2,700 small spills per billion barrels. Epstein (2002) estimates one (small) pipeline spill per month in the Cook Inlet watershed, onshore and offshore, per month from 1997 through 2001.

The oil industry is not the only or necessarily the primary spiller in Cook Inlet. In the State of Alaska, OGCC (1981) previously discussed, there were a reported 269 nonpetroleum-industry oil spills; the reported amount of oil spilled for 206 of the spills was 22,746 barrels—no volume was reported for 63 spills. (Nonpetroleum-industry spills included spills from fishing boats, vessels carrying refined products to communities, and other vessels.) The *Oil Spill Intelligence Report* (2001a) found that nontank vessels and other unregulated operators had tenfold higher occurrence rates and fiftyfold higher volume spillage than oil industry and other regulated operators in Alaskan waters. This spillage includes sinking of nontank vessels such as tugboats (Associated Press, 1989) and fishing vessels (*Oil Spill Intelligence Report*, 2001b). Oily ballast water discharges have occurred (Federal Water Pollution Control Administration, 1970) and are still occurring in the Gulf of Alaska, including Cook Inlet. Significant enforcement actions have recently had to be taken against both cargo fleets (*Oil Spill Intelligence Report*, 2002a) and cruise ship fleets (Henderson, 1999; *Golob's Oil Pollution Bulletin*, 1998) operating in the Gulf of Alaska for deliberately and illegally discharging oily waste.

Oil sheens observed on the water surface are another source of information about vessel oil spills. During surveillance flights in Prince William Sound and the Gulf of Alaska between September 1989 and September 1990, 260 sheens observed were attributed to sources other than *Exxon Valdez*; i.e., fishing boats, recreational boats, and cruise ships (Taft, Egging, and Kuhn, 1995); the number of non-*Exxon Valdez* slicks was about 31% of the total number of slicks observed. The estimated amount of oil in these sheens totaled about 8,100 liters (about 193 barrels) and ranged from less than 1 to 6,000 liters; the largest spill consisted of diesel fuel from a cruise vessel.

III.A.4.b. Constituents of the Marine Environment

III.A.4.b(1) Monitoring Studies

Multiple, significant regional monitoring studies have been conducted in Cook Inlet and downcurrent, in Shelikof Strait conducted particularly by the MMS (including Outer Continental Shelf Environmental Assessment Program studies) and the Cook Inlet Regional Citizens Advisory Council. The Prince William Sound Regional Citizens Advisory Council has conducted a long-term monitoring program from Prince William Sound to Shelikof Strait. These studies have examined water, biota, suspended sediments, bottom sediments, and the intertidal shoreline. Numerous parameters were used to evaluate existing water and sediment quality of Cook Inlet and Shelikof Strait. Some of the parameters and procedures that have been used to evaluate water and sediment quality are:

- Measurement of hydrocarbon and trace-metal concentrations in sediment.
- Identification of anthropogenic portion of sediment contaminant loads.
- Comparison of sediment concentrations to “effects levels”; that is, to concentrations below which effects are seldom found.
- Comparison to local and global concentrations (i.e., are they higher or lower than elsewhere?).
- Time trends in sediment levels (i.e., have concentrations or accumulation rates of contaminants increased since oil development started in Cook Inlet?).
- Comparison of anthropogenic loading to natural source loading.
- Measurement of acid volatile sulfide levels and simultaneously extractable metals, a technique used to measure metal toxicity in sediments (see Gray, 1999).
- Measurement of sediment toxicity (bioassays).
- Measurement of repeater gene system in sediment as an indicator of biologically available contaminants in sediments.
- Measurement of repeater gene system in tissue as an indicator of the presence of contaminants in the organism.
- Measurement of cytochrome P450 (CYP1A) activity, an enzyme indicator that the organism is trying to counteract contaminants.

- Measurement of hydrocarbons and metals in tissues and organs, indicator of biologically-available contaminant levels.
- Measurement of physiological condition of biota, indicator of whether environmental stress, including contaminants.
- Measurement of abundance of hydrocarbon-degrading microorganisms, indicator of oil contamination.
- Visual (photographic) examination of the sediment/water interface (Sediment Profile Imaging; Arthur D. Little and EVS Environmental Consultants, 1999), including:
  - visual (photographic) "health" inspection of and across the sediment/water interface,
  - depth of Redox Potential Discontinuity, an indicator of organic contaminant loading,
  - infaunal stage, indicator of disturbance/disruption, and
  - calculation of the Organism-Sediment Index, a constructed statistic that combines Sediment Profile Imaging-derived parameters into a sediment health index.

The general conclusion of these studies is that the existing water and sediment quality of Cook Inlet and Shelikof Strait is good. The more critical of these evaluation parameters in reaching this conclusion are detailed in the rest of Section III.A.4.

III.A.4.b(2) Salinity

Cook Inlet waters are influenced by riverine and marine input. During summer and fall, salinity varies from 32‰ at the entrance to lower Cook Inlet to approximately 26‰ at the West Forelands (Rosenberg et al., 1967; Kinney, Groves, and Button, 1970; Wright, Sharma, and Burbank, 1973; Gatto, 1976; Feely et al., 1979; Muench, Mofjeld, and Charnell, 1978). There is a characteristic isohaline (lines of equal salinity) bending resulting from high-salinity water on the eastern side and low-salinity water on the western side of the inlet. The surface salinity contours in lower Cook Inlet are affected by tidal currents.

Shelikof Strait is influenced by the diluted seawater flow from Cook Inlet and the inflow of the Alaska Coastal Current into Shelikof Strait primarily through Kennedy Entrance. Surface salinity is at a maximum in February and at a minimum in October (Reed and Schumacher, 1989a,b). Surface water along the Peninsula side is more diluted due to discharge from lower Cook Inlet. The middle strait has salinities less than 32‰ similar to Kennedy Entrance. Saline water, greater than 32‰, exists in deeper portions of the Strait (Kim, 1986).

III.A.4.b(3) Oxygen, Phosphate, Nitrate, Nitrite, Ammonia, and Silicate in the Water Column

The concentration of oxygen in the surface waters of Cook Inlet ranges from about 7.6 milliliters per liter in the northern part to 10 milliliters per liter in the southwestern part; none of the waters in the inlet is oxygen deficient (Kinney, Groves, and Button, 1970). The concentration ranges of other chemical parameters included phosphate 0.31-2.34 parts per billion (parts per billion), nitrate 0-23.5 parts per billion, nitrite 0.02-0.52 parts per billion, ammonia 0.2-3.1 parts per billion, and silicate 9-90 parts per billion (Kinney, Groves, and Button, 1970). In general, the concentration of phosphate increases toward the mouth of Cook Inlet while the concentrations of nitrate and silicate decrease; the silicate concentration appears to be directly related to the suspended-sediment load (Kinney, Groves, and Button, 1970).

III.A.4.b(4) Suspended-Particulate Matter

The distribution of suspended-particulate matter in Cook Inlet shows horizontal gradients in both the longitudinal and cross-inlet directions (Feely and Massoth, 1982). The suspended-particulate matter concentration ranges are (1) about 800-1,600 parts per million (milligrams per liter) (Table III.A-1) in the Knik, Susitna, and Matanuska rivers from May through October; (2) 1,000 parts per million in the northeastern end of upper Cook Inlet to about 100 parts per million north of the Forelands (Sharma, 1979); and (3) greater than 50 parts per million south of the Forelands to 1-5 parts per million in Shelikof Strait (Feely and Massoth, 1982). Along the eastern side of Cook Inlet, the concentrations are low, ranging from 0.5 parts per million near the southwestern end of the Kenai Peninsula to about 5 parts per million north of Cape Ninilchik. The suspended particulate matter concentrations on the western side of Cook Inlet range from greater than 100 parts per million north of Tuxedni Bay to about 5 parts per million in the vicinity of Kamishak Bay.

The suspended particulate matter distribution in Cook Inlet is affected by the tidal currents, estuarine and embayment circulation regimes, meteorological events (winds), wind-generated waves and surface currents, Coriolis force, and inlet shape and bathymetry (Hampton et al., 1986; Muench, Mofjeld, and Charnell, 1978; Burrell and Hood, 1967). Tidal currents are the dominant factor affecting the distribution. These phenomena produce considerable turbulence and crosscurrents in the water column during both ebb and flood tides (Burrell and Hood, 1967, as reported in Gatto, 1976). The cumulative effects of dynamic processes and the similarity of suspended particulate matter concentrations, as well as salinities and temperatures, at the surface and near the bottom, suggest the water column in lower Cook Inlet generally is vertically well mixed (Hampton, et al., 1986; Gatto, 1976; Sharma, 1979; University of Alaska Anchorage (UAA), Environment and Natural Resources Institute (ENRI), 1995); stratified water masses occur near the entrance to the inlet (Sharma, 1979), and very poorly developed stratification may develop during peak river discharge (Gatto, 1976). For more information on the circulation, tides, and other features associated with the physical oceanography of Cook Inlet, see Section III.A.3.

The major regions of deposition of the suspended particulate matter, in order of decreasing importance, are Shelikof Strait, Kamishak Bay, and Kachemak Bay (Feely et al., 1981; Boehm 2001a). In the central part of lower Cook Inlet, the seafloor sediments primarily consist of unconsolidated coarse-grained sands and gravels deposited during the retreat of the Pleistocene glaciers (Bouma and Hampton, 1976, as reported in Feely et al., 1981); these sediments indicate a nondepositional environment, especially for suspended-particulate matter in the water column. Where suspended particulate matter, particularly silts and clays, is deposited is important, because most contaminants in Cook Inlet (and elsewhere) are intimately associated with the suspended and then bottom sediments (see Boehm 2001a; Henrichs, Luoma, and Smith, 1997; Braddock and Richter, 1998).

The concentration of suspended particulate matter in Shelikof Strait ranges from 0.3-2 parts per million (Hampton et al., 1986). The suspended-particulate matter, temperature, and salinity characteristics of the strait show evidence of cross-channel gradients similar to those in lower Cook Inlet (Hampton et al., 1986). These similarities suggest the processes affecting the characteristics of the water in lower Cook Inlet also are occurring in Shelikof Strait. The net movement of water and suspended particulate matter in the strait is to the southwest, away from Cook Inlet. The surficial sediments in the main biochemical oxygen demand of Shelikof Strait are derived mainly from Cook Inlet (Hampton et al., 1986; Trefry, 2000; Boehm, 2001a). About 10-20% comes from the Copper River. In depositional areas within Kamishak and Kachemak bays and the northeastern mouth of Shelikof Strait, the sediment accumulation rates are about 20 centimeter per 100 years; with 140 centimeters per 100 years just outside of Homer Harbor (Zones 0 and 1; Boehm, 2001a). In the rest of Shelikof Strait, the sediment accumulation rates are on the order of 70 centimeters per 100 years (Zones 2, 3, and 4; Boehm, 2001a). Most of the sediments from the Alaska Peninsula and Kodiak/Afognak Island group are deposited behind the sills at the mouths of the fjords.

III.A.4.b(5) Naturally Occurring Radioactive Materials

Naturally occurring radioactive materials (NORM) likely occur in Cook Inlet in low concentrations if for no other reason than they occur in the bedrock around the basin (Dickinson, 1977). NORM are best monitored indirectly, taking advantage of natural biological or chemical concentration mechanisms such as shell formation (Farrington et al, 1983; Goldberg et al., 1983). The UAA, ENRI (1995) analyzed mussel shells from sites in Cook Inlet and found very low NORM levels in all shells analyzed. Radium-226, radium-228, and bismuth-214 were not detectable and lead-214 was extremely low.

III.A.4.b(6) Hydrocarbons in the Marine Environment

III.A.4.b(6)(a) Hydrocarbons in the Water Column

III.A.4.b(6)(a)1) Total Hydrocarbons

The total hydrocarbon content of lower Cook Inlet seawater, based on analyzing unfiltered surface seawater samples, ranged from 0.2-1.5 parts per billion; analysis of the hydrocarbon compounds indicated they probably were biologically produced (Shaw, 1980). Land plants, algae, bacteria, zooplankton, and other animals synthesize or decompose into multiple hydrocarbons, which can be distinguished from those anthropogenic sources.

III.A.4.b(6)(a)2) Low-Molecular-Weight Hydrocarbons

The low-molecular weight hydrocarbons (hydrocarbon compounds with 1-4 carbon atoms [C_1-C_4] that include methane, ethane, and propane) in the water column of lower Cook Inlet were similar to their respective concentration in other Alaskan environments (Katz and Cline, 1981) (Table III.A-16). The concentrations of methane ranged from 55-3,072 nanoliters per liter (0.055-3.072 microliters per liter); concentrations of the other low-molecular weight hydrocarbons were less than 7 nanoliters per liter. The methane and other low-molecular weight hydrocarbons in lower Cook Inlet were derived from biosynthesis (Katz and Cline, 1981).

In upper Cook Inlet, the concentrations of methane ranged from 138-4,085 nanoliters per liter and were higher than those in lower Cook Inlet and other Alaskan waters. The highest methane concentrations were found in Trading Bay (Katz and Cline, 1981); producing oil fields are located in Trading Bay and gas fields, both producing and nonproducing, are located nearby. The characteristics of the low-molecular weight hydrocarbons in the waters of upper Cook Inlet suggest they are thermogenic in origin and could have entered the marine environment from submarine seeps or leakage from existing wells. The natural gas commercially produced in Cook Inlet principally consists of methane (greater than 98%) and trace amounts of the higher hydrocarbons (Katz and Cline, 1981). Methane concentrations decreased away from Trading Bay to levels similar to those found in lower Cook Inlet. Some of the general trends for ethane and propane were similar to those of methane.

III.A.4.b(6)(a)3) Volatile Organic Aromatic Compounds

The concentrations of volatile organic aromatic compounds (benzene, ethylbenzene, toluene, total xylenes, and dichlorobenzenes) in the water column at eight stations were less than the method-detection limit—1 parts per billion (UAA, ENRI, 1995).

III.A.4.b(6)(a)4) High-Molecular-Weight Hydrocarbons

Neither saturated nor unsaturated high-molecular weight hydrocarbons (C_{14}-C_{35}) were detected in the filtered seawater and suspended particulate matter fractions in the surface waters collected in the vicinity of the offshore oil-production platforms in upper Cook Inlet and on the east and west sides of Kalgin Island (Shaw, 1980).

The total concentrations of saturated hydrocarbons, n-alkanes C8 to C36, in water samples collected in 1993 ranged from less than the detection limit (0.01 parts per billion) to 4.14 parts per billion (UAA, ENRI, 1995).

In November 1993, Marathon Oil Company sampled the waters of Trading Bay north, east, and south of Trading Bay Treatment Facility discharge-pipe outfall for hydrocarbons (Neff and Douglas, 1994). The outfall is located 3.2 kilometers (1.71 nautical miles) offshore in waters about 10 meters deep. Twenty-nine samples were collected within several hours of the slack tide 50, 300, and 750 meters from the outfall at depths of 1 meter below the surface and 1 meter above the bottom; water depths at the sample sites ranged from 10-18 meters. Although two samples of treated produced waters from the Trading Bay Treatment Facility were also analyzed and contained about 3,600 and 3,920 parts per billion of resolved alkanes (saturated hydrocarbons between C8 and C40), no detectable amounts of saturated hydrocarbons (C8-C40), individual or total, were found in the water samples. The concentrations of individual alkanes in the treated produced waters ranged from less than 5 parts per billion to about 270 parts per billion. The reporting limit for the individual alkanes was 0.2 parts per billion, and the total was 50 parts per billion.

III.A.4.b(6)(a)5) Polycyclic Aromatic Hydrocarbons

In the Cook Inlet Regional Citizens Advisory Council pilot study (Hyland et al., 1995), mussels (*Mytilus edulis)* were used to determine polycyclic aromatic hydrocarbon bioavailability in the water column (Hyland et al., 1995); the mussels were suspended in the water column for a month in the Beluga River and

Trading Bay areas. The polycyclic aromatic hydrocarbon assemblages in the mussels were less diverse than they were for pre-exposure mussels. Prior to exposure, the mean polycyclic aromatic hydrocarbon concentration of the mussels was 84 parts per billion (nanograms per gram wet weight). Following suspension in the water column for a month, the mean polycyclic aromatic hydrocarbon concentration in the mussels from the (1) Beluga River site was 94 parts per billion (the increase was due mainly to higher concentrations of alkyl naphthalenes), and (2) the Trading Bay site was 24 parts per billion. The lack of chronically available hydrocarbons (except possibly some naphthalenes), at the exposure sites apparently provided an opportunity for these organisms to cleanse themselves of most of the polycyclic aromatic hydrocarbons while suspended in the water column.

Total polycyclic aromatic hydrocarbon concentrations in the Cook Inlet waters sampled by UAA, ENRI (1995) were below the detection limit (0.01 parts per billion).

The concentrations of total polycyclic aromatic hydrocarbons in the water samples collected near the outfall of the Trading Bay Treatment Facility ranged from 0.029-0.889 parts per billion (Neff and Douglas, 1994); the concentration of most of the individual polycyclic aromatic hydrocarbons was below the 0.01-parts per billion-reporting limit. The concentrations of total polycyclic aromatic hydrocarbons in the treated produced-water samples were about 837 and 883 parts per billion. The most abundant polycyclic aromatic hydrocarbons in the produced-water samples were alkylnaphthalenes and alkylphenanthrenes.

Except for one sample, no benzene, toluene, ethylbenzene, and total xylenes compounds were detected in the water samples (Neff and Douglas, 1994); the detection limit for these hydrocarbons was approximately 1.0 parts per billion. The sample with 0.889 parts per billion of total polycyclic aromatic hydrocarbons also contained 5.6 parts per billion benzene, toluene, ethylbenzene, and total xylenes; this sample was collected 50 meters south of the outfall, and the high values of aromatic hydrocarbons may have been caused by the presence of an oil microdrop or by contamination. A treated produced water sample contained 6,860 parts per billion benzene, toluene, ethylbenzene, and total xylenes.

The total amount of polycyclic aromatic hydrocarbons in the suspended particulate matter from surface and bottom water samples collected at three sites 750 meters north, east, and south the Trading Bay outfall were determined (Neff and Douglas, 1994). The total polycyclic aromatic hydrocarbon concentrations in the suspended particulate matter ranged from about 19-136 parts per billion; the suspended particulate matter concentration in the samples ranged from 0.5-3 parts per million. Individual polycyclic aromatic hydrocarbons that were detected in the suspended particulate matter samples generally were below the reporting limit of 10 parts per billion. The surface water sample from north of the outfall contained traces of polycyclic aromatic hydrocarbons that are common in pyrogenic polycyclic aromatic hydrocarbon assemblages. The most abundant of the higher molecular weight polycyclic aromatic hydrocarbons was perylene. Perylene primarily is derived from biogenic sources but may be present in small amounts in petrogenic and pyrogenic polycyclic aromatic hydrocarbon assemblages.

III.A.4.b(6)(a)6) Toxicity

Waters from eight stations were collected for a 48-hour liquid-phase sperm-cell sublethal bioassay to determine fertilization rates of the sand dollar *D. excentricus*; four stations were located in both upper and lower Cook Inlet (UAA, ENRI, 1995). In the sublethal sperm-cell test, the mean fertilization rates of *D. excentricus* in the sampled waters from five stations were reduced by a statistically significant amount; four of the stations were located in upper Cook Inlet and one station in lower Cook Inlet south of Kalgin Island. The reduced fertilization rate for three of the stations was less than 6% compared to the control and was not considered an indication of toxic waters. The reduced fertilization rate for the two northernmost stations was 15% lower than the control and could be an indication of toxic waters. The waters from the two northernmost stations had high concentrations of suspended particulate matter that may have contributed to the toxicity.

With the exception of the station in Kamishak Bay, there were no statistically significant differences between the survival of *D. excentricus* larvae in samples waters and control waters in the acute 48-hour-developmental tests (UAA, ENRI, 1995). Larvae exposed to waters from the Kamishak Bay site had a survival rate that was less than 10% of the control.

III.A.4.b(6)(b) Hydrocarbons in the Surficial Sediments and Benthic Biota

Fossil-fuel hydrocarbons that enter the water column may be adsorbed by detrital particles, deposited in the sediments, or sorbed by benthic organisms. Thus, the sediments and benthic organisms also can be used to determine if petroleum hydrocarbons are or were present in the water column.

III.A.4.b(6)(b)1) Bottom Sediments

III.A.4.b(6)(b)1)a) Total Organic Carbons

In late 1971, the total organic carbon content of the subtidal sediments of Cook Inlet and the northern part of the Shelikof Strait ranged from 0.1-1.4% (Kaplan et al., 1980; Venkatesan and Kaplan, 1982). The low total organic carbon content of the sediments in Cook Inlet and Shelikof Strait is characteristic of unpolluted, relatively coarse sediments.

The total hydrocarbons in the sediments collected for the Cook Inlet Regional Citizens Advisory Council pilot study ranged from 0.12-0.77%; concentrations greater than 0.5% were found in the sediments from Kachemak Bay (Hyland et al., 1995).

The total organic carbons in all but one of the sediments sampled in the UAA, ENRI (1995) study ranged from 0.05-1.57%—these values generally were within the range of total organic carbon found in the sediments sampled in late 1971 (Kaplan et al., 1980; Venkatesan and Kaplan, 1982). The total organic carbons in the sediment from a station located off the southwest end of the Kenai Peninsula were 4.09%; this relatively high concentration probably represents a piece of wood or coal in the sample (UAA, ENRI, 1995).

The concentration of total petroleum hydrocarbons in three surface sediment samples from a depositional area 2 mi northeast of the Trading Bay Treatment Facility outfall ranged from 8.97-13.76 parts per million (Neff and Douglas, 1994). The total concentration of resolved saturated hydrocarbons ranged from 1.07-2.56 parts per million. Only n-alkanes with 19 or more carbon atoms were present in concentrations greater than 0.1 parts per million; the most abundant alkanes were C_{25}, C_{27}, and C_{29} alkanes and probably were derived mainly from plant waxes.

III.A.4.b(6)(b)1)b) High-Molecular-Weight Hydrocarbons

The high-molecular weight hydrocarbons (C_{15}-C_{35}) detected in the intertidal and subtidal surface sediments of Cook Inlet mainly consisted of mixtures of compounds produced by terrestrial plants and by marine plants, zooplankton, and bacteria (Kaplan et al., 1980; Venkatesan and Kaplan, 1982; Shaw, 1977, 1981). Based on dry weight, the aliphatic hydrocarbons ranged from 0.43 to 28.81 parts per million (micrograms per gram dry weight), the aromatics 0.27-23.81 parts per million, and the total n-alkanes less than 0.01 to 3.66 parts per million (Kaplan et al., 1980). Odd-numbered hydrocarbon compounds generally were more abundant than the even-numbered hydrocarbons; ratios of odd-number C compounds to even-number C compounds greater than 1.5 indicate hydrocarbons of biogenic origin (Kaplan et al., 1980; Shaw, 1977, 1981).

The high-molecular weight hydrocarbons found in the sediments (from two sites) north of Kalgin Island were derived from petroleum (Kaplan et al., 1980; Venkatesan and Kaplan, 1982). The source of the petroleum hydrocarbons in these sediments may be from petroleum-production facilities located north of the Forelands, spills or discharges associated with petroleum transportation, or localized seeps. However, the sediments east and west of Kalgin Island did not show evidence of any petroleum residue (Kaplan et al., 1980; Venkatesan and Kaplan, 1982). The high-molecular weight hydrocarbons from coal were found in the sediments off Bluff Point (Shaw, 1981). The coal in these sediments might have come from coal outcrops in the Anchor Point-Bluff Point area.

The mean total concentration of n-alkanes (n-C_{12} to n-C_{32}) in the 1993 sediment samples ranged from 62-2,666 parts per billion (ng/g dry weight) (UAA, ENRI, 1995). The n-alkanes with 21-29 C atoms dominated, especially C_{27} and C_{29}. There also was a strong preference for compound with odd-numbered C atoms over compounds with even-numbered C atoms. These characteristics indicated the saturated hydrocarbons were of biogenic origin, derived mainly from terrestrial plants.

III.A.4.b(6)(b)1)c) Polycyclic Aromatic Hydrocarbons

The subtidal sediments also contained polycyclic aromatic hydrocarbons derived from the high temperature (400-800 °Celsius [Hunt, 1979]), incomplete combustion of wood (forest fires), or fossil fuels. In the Outer Continental Shelf Environmental Assessment Program studies, the concentrations of the individual compounds in the sediments ranged from not detected or trace to 266 parts per billion. Winds and rivers could transport these hydrocarbons into the area from combustion sites located nearby or far away (Kaplan et al., 1980; Venkatesan and Kaplan, 1982).

The total polycyclic aromatic hydrocarbon concentrations in the sediments from the Cook Inlet Regional Citizens Advisory Council pilot study were less than or equal to 105 parts per billion at all stations and less than parts per billion at most stations (Hyland et al., 1995). A few individual polycyclic aromatic hydrocarbon concentrations from several of the sediment samples exceeded 10 parts per billion, but most ranged near the detection limits of 1-5 parts per billion. The polycyclic aromatic hydrocarbon distribution in the sediments from two of the samples sites, one off the Beluga River and the other in Trading Bay, were similar to the polycyclic aromatic hydrocarbon distribution in the produced-water outfall in Trading Bay. The polycyclic aromatic hydrocarbon distribution in the other two samples from the Beluga River and Trading Bay sampling areas were similar to those in the samples from Kachemak Bay. The samples from Kachemak Bay contained greater perylene concentrations than did the other sediment samples. Perylene (1) is a naturally occurring polycyclic aromatic hydrocarbon formed by the chemical transformation of certain biological precursors, possibly plant pigments, in sediment during early diagenesis (Wakeha et al., 1980, as reported in Hyland et al., 1995) and (2) occurs in crude oil in low concentrations. The concentrations of the polycyclic aromatic hydrocarbons in the sediment samples are within the range of concentrations observed in unpolluted coastal and offshore environments.

The total polycyclic aromatic hydrocarbon concentrations in the sediments sampled in 1993 ranged from less than 2 to 958 parts per billion (UAA, ENRI, 1995); these concentrations are similar to the concentrations found in past Cook Inlet studies. In only about one-fifth of the samples were the concentrations of polycyclic aromatic hydrocarbon greater than 10 parts per billion; polycyclic aromatic hydrocarbons were not detected in about one-half of the samples collected. The phenanthrene series were dominant in many of the samples with detectable polycyclic aromatic hydrocarbons, and this indicates hydrocarbons of petrogenic origin. A sample from a station located in Kachemak Bay had higher total polycyclic aromatic hydrocarbon concentrations and levels of naphthalene compounds than samples from other locations; the more volatile naphthalene compounds indicate relatively recent petroleum inputs, and this could be an indication of pollution from the Homer vicinity (UAA, ENRI, 1995).

The polycyclic aromatic hydrocarbon concentrations in the sediments northeast of the Trading Bay outfall ranged from 93.3-116.2 parts per billion (Neff and Douglas, 1994). The assemblage indicated the polycyclic aromatic hydrocarbons in these sediments were derived mainly from pyrogenic sources. Perylene, derived primarily from the diagenesis of biogenic matter, was the most abundant high-molecular weight hydrocarbon in the sediments. The benzene, toluene, ethylbenzene, and total xylenes compounds were not detected in the sediments.

The MMS conducted an extensive sampling for sediment quality in depositional areas in outermost Cook Inlet and Shelikof Strait in 1997-1998 (Boehm, 2001a). Hundreds of samples were analyzed for contaminants possibly related to oil and gas industry. Total polycyclic aromatic hydrocarbon averaged 459 parts per million. Analyses of dated sediment cores demonstrate that the concentrations or accumulation rates for hydrocarbons have not increased at least over the past few decades (since before offshore oil exploration and production in Cook Inlet. The concentrations of total polycyclic aromatic hydrocarbon found by Boehm and others in Cook Inlet and Shelikof Strait ran and ranges from less than 1 to 1,080 parts per billion (Table III.A-17). The highest concentrations tend to occur in the southeast corner of Cook Inlet and on the Kodiak side of Shelikof Strait.

These higher concentrations are the result of a combination of eroded coal and oil source rock plus seep oil being deposited in sediments by the coastal current entering Cook Inlet from the eastern Gulf of Alaska. The concentrations downcurrent of Cook Inlet are actually diluted up to several fold by Cook Inlet discharge. This results in highest concentrations of hydrocarbons in coastal sediments where the influence of estuarine Cook Inlet discharge is the least, particularly in eastern lower Cook Inlet and the Kodiak side of Shelikof Strait (see Boehm, 2001a).

III.A.4.b(6)(b)1)d) Toxicity

As part of the Cook Inlet Regional Citizens Advisory Council pilot study, sediment toxicities were measured with the marine amphipod *Ampelisca abdita* and the benthic clam *Macoma* spp. The polycyclic aromatic hydrocarbon distributions in the tissues of clams from the Kamishak Bay and Kachemak Bay sampling sites were different than the polycyclic aromatic hydrocarbon distributions in the sediments and consisted mainly of biogenic polycyclic aromatic hydrocarbons.

The survivability, after 10 days, of amphipods in the sediments from the four sampling areas (off the mouth of the Beluga River and in Trading, Kamishak, and Kachemak Bays) ranged from 61% to about 87%; the survivability in control sediments was 91%. The mortality of the amphipods did not appear to be related to any of the sediment parameters (total organic carbon, polycyclic aromatic hydrocarbon, and grain size) measured in the study but may have been caused by the presence of natural or manmade substance or substances not analyzed in the study.

The results of the bioassays indicate some of the sediments and pore waters from 12 stations sampled may contain substances sublethally toxic to the test organisms, although the causes are unknown (Table III.A-18) (UAA, ENRI, 1995). Amphipod 10-day-static sublethal bioassays (survival of *R. abronius* larvae) were conducted on sediment samples from all 12 stations, Microtox® bioassays were conducted on sediments from 11 stations, and mean fertilization rates of *D. excentricus* eggs bioassays were conducted in the sampled sediment pore waters from nine stations. All three bioassays were conducted on samples from 8 of the 12 stations, and two bioassays were conducted on samples from 4 stations.

The bioassays at three of the stations where all three bioassays were conducted did not indicate the presence of any substances in quantities great enough to be sublethally toxic to the test organisms (UAA, ENRI, 1995). Two of these stations were located in upper Cook Inlet (one in Trading Bay) and the other in lower Cook Inlet. However, the presence of sublethal levels of toxic substances may be indicated by two of the three tests that were conducted on samples from four stations. At three of these stations, both the Microtox® and fertilization rate bioassays indicated toxic substances may be present; these stations were located near the southern end of Kalgin Island, in Tuxedni Bay and near the central part of the inlet off Tuxedni Bay. Also, the Microtox® and amphipod survival bioassays of samples from a Kachemak Bay station indicated toxic substance may be present. Bioassays on a sample from Trading Bay indicated substances that may be toxic in the amphipod survival test may be present but absent, or not detected, in the fertilization bioassay.

The individual bioassays indicated toxicity to the test species may be present in (1) 2 of the 12 amphipod survival stations (1 station in Trading Bay and the other in Kachemak Bay), (2) 5 of the 11 Microtox® stations (4 of the stations along the western side of lower Cook Inlet and the Kachemak Bay station), and (3) 3 of the 9 fertilization-rate stations (located along the western side of Cook Inlet—3 of the Microtox® stations) (UAA, ENRI, 1995).

Results of two additional sets of amphipod toxicity assays in combination with chemical measurements (Boehm 2001a) indicated that hydrocarbons and metals were not the cause of occasional toxicity found. Some low survival rates appeared to be rated to very high silt content in finer sediments.

III.A.4.b(6)(b)2) Benthic Biota

III.A.4.b(6)(b)2)a) Cook Inlet

In the Outer Continental Shelf Environmental Assessment Program studies, hydrocarbons were determined in the benthic biota from specimens collected at various sites throughout lower Cook Inlet. The biota included brown, green, and red algae; angiosperms; limpets; bryozoan; clams; mussels; snails; and urchins (Shaw, 1979, 1980). Based on dry weight, the concentrations of saturated and unsaturated hydrocarbons in the benthic (1) plants ranged from 2.08-1,880 parts per million and 3.05-157 parts per million, respectively, and (2) animals from 0.55-1,550 parts per million and 1.24-591 parts per million, respectively.

Most of the organisms analyzed contained only those hydrocarbons produced by contemporary biological processes (Shaw, 1980). In most of the specimens, the unsaturated hydrocarbons were more abundant than the saturated. Odd-numbered C compounds generally were more abundant than the even-numbered C compounds. Animal species often contained an array of hydrocarbons similar to that of their algal food sources.

Several of the plant and animal specimens also contained an array of compounds that suggested some of the hydrocarbons were derived from either petroleum or coal. Specimens of rockweed, a brown algae (*Fucus gardneri* [previously *F. distichus*]), from within the boat harbor on the Homer Spit contained an array of high-molecular weight hydrocarbons derived from petroleum; the habitat from which the specimens came suggests contamination from fuel oil. A red algae species (*Constantinea subulifera*) from an area adjacent to Bluff Point contained an array of hydrocarbons characteristic of the detrital coal and intertidal muds of the Anchor Point/Homer area (Shaw, 1979); coal outcrops are found on Bluff Point.

Data are also available for the deposit-feeding clam, *Macoma balthica*. The high-molecular weight hydrocarbon compounds found in *M. balthica*, obtained from the mudflats east of the Homer Airport contained a suite of compounds similar to those found in terrigenous plants and in the coal from the Homer area (Shaw, 1979). Six samples of *M. balthica* were collected and analyzed from subtidal areas in Kamishak and Kachemak bays in Cook Inlet Regional Citizens Advisory Council's Pilot Program in 1993 (Hyland et al., 1995). The total polycyclic aromatic hydrocarbon concentrations ranged from 0-71 parts per billion dry weight. Eight samples of *M. balthica* collected in 1996 from Chinitna Bay and Tuxedni Bay in the Cook Inlet Regional Citizens Advisory Council's Lake Clark Bivalve Study had higher concentrations of total polycyclic aromatic hydrocarbon ranging from 271-408 parts per billion dry weight; Kinnetic Laboratories and Texas A&M, GERG, 1996). These higher concentrations were thought to show a fresh petrogenic signature, with high naphthalene and low chrysenes indicative of a refined petroleum product such as diesel. A more recent Cook Inlet Regional Citizens Advisory Council study, Lees et al. (2002), examined this issue more closely and argues that the high naphthalene content is indicative of a natural, peat source. Lees et al. found total polycyclic aromatic hydrocarbon in 10 *M. balthica* samples ranging from less than 32 to 1,300 parts per billion. The hydrocarbon fingerprints indicated that *M. balthica* had not been exposed detectable concentrations of petroleum hydrocarbons.

Specimens of *Mytilus edulis* obtained from the mudflats east of the Homer Airport contained an array of high-molecular weight hydrocarbons that indicates the presence of fuel oil, which may be the result of pollution from the nearby town and boat harbor (Shaw, 1979).

Mussels, *M. edulis*, were collected from six locations in lower Cook Inlet in 1993 (UAA, ENRI, 1995) and three samples from two locations in 2001 (Lees et al., 2002). In the 1993, samples, the total concentration of the saturated hydrocarbons ranged from 0-1,800 parts per billion (nanogram per gram wet weight); individual n-alkanes concentrations ranged from less than 0 to 2,300 parts per billion). The compounds with 21-29 C atoms dominated, which indicates hydrocarbons of biogenic origin. No saturated hydrocarbons were detected in the tissue of mussels from Chitina Bay and Fossil Point; the saturated hydrocarbons in the tissues of mussels from a station in Tuxedni Bay were 13,800 parts per billion. Total concentration of selected polycyclic aromatic hydrocarbons ranged from 0-400 parts per billion. No polycyclic aromatic hydrocarbons were detected in the tissues of mussels from Kasitsna Bay and Homer sites. In the 2001 samples, total polycyclic aromatic hydrocarbon concentrations ranged from less than 8 to 55 parts per billion. No petroleum hydrocarbons were detected in the 2001 samples.

In 1989 and/or 1990, multiple samples of razor clams were collected from three oiled and four control sites in Cook Inlet following the *Exxon Valdez* spill (Baker, 1996). Control site average concentrations of polycyclic aromatic hydrocarbons in razor clam tissue were 26 parts per billion (per wet weight) in 1989 and 30 parts per billion in 1990. Oiled sited average concentrations in razor clam tissue were 133 parts per billion in 1989 and 92 parts per billion in 1990. For comparison, razor clams from oiled sites in Prince William Sound averaged 1,010 parts per billion polycyclic aromatic hydrocarbons in 1989 and 84 parts per billion in 1990. The rapid drop off in razor clam concentrations of polycyclic aromatic hydrocarbon between 1989 and 1990 is likely due to low persistence of oil in energetic, coarser beaches inhabited by razor clams. More recent, limited measurements on six razor clam samples from three locations in Cook Inlet in 2001 ranged from less than 12 to 25 parts per billion total polycyclic aromatic hydrocarbons, at uncontaminated background (Lees et al., 2002).

III.A.4.b(6)(b)2)b) Mouth of Cook Inlet and Shelikof Strait

The Prince William Sound Regional Citizens Advisory Council conducts a long-term monitoring program using hydrocarbon levels in mussel *M. edulis* tissue as an indicator of hydrocarbon contamination. Two of the stations, Windy Bay just to the east (upcurrent) and Shuyak Harbor just to the west (downcurrent) straddle the mouth of Cook Inlet. Mussels from both locations consistently show only inputs from background sources with some but less pyrogenic or biogenic input (Kinnetic Laboratories, 1994, 1995, 1996a, 1997, 1998a, 1999, 2000).

The Cook Inlet Regional Citizens Advisory Council also collected and analyzed mussels in 1996 (Kinnetic Laboratories and Texas A&M, GERG, 1997) from three sites in Shelikof Strait. Mussels from one of the locations, Cape Nukshak had twofold elevated total polycyclic aromatic hydrocarbon concentrations 450 parts per billion (dry weight), and an individual polycyclic aromatic hydrocarbon composition suggestive of Alaska North Slope crude or diesel. Concentrations at the other two sites were similar to those from the Prince William Sound Regional Citizens Advisory Council sites.

III.A.4.b(6)(c) Biodegradation

Hydrocarbon-oxidizing microbes were found throughout the waters (Kinney, Button, and Schell, 1969; Button et al., 1970; Atlas et al., 1983) and sediments (Roubal and Atlas, 1978; Braddock and Richter, 1998; Boehm 2001a) of Cook Inlet and Shelikof Strait, and their presence indicates biodegradation is a continuing process. In upper Cook Inlet, microbe concentrations range from 1,000-10,000 organisms per liter, and in lower Cook Inlet their concentration range from 100-10,000 organisms per liter in the northern part and 10-1,000 in the southern part; about 10% of the population is capable of oxidizing petroleum. The oil-oxidizing microbes appear to be more abundant closer to shore than in the central part of the inlet (Atlas et al., 1983). Highest concentrations of oil-oxidizing microbes occurred in the northern portion of Kamishak Bay in Oil Bay (near seeps).

These numbers are indicative that hydrocarbon loading to Cook Inlet is too low to maintain an enhanced oil-oxidizing microbe population (Atlas et al., 1983; Boehm, 2001a). However, the microbe concentrations are high enough to be important in removal of oil from Cook Inlet. Kinney, Button, and Schell (1969) found that oil-oxidation by microbes was the primary removal process for Cook Inlet crude spilled or discharged in Cook Inlet, with the process essentially complete within 1-2 months.

III.A.4.b(7) Metals in the Marine Environment

III.A.4.b(6)(a) Suspended Particulate Matter

The concentrations of metals associated with the suspended particulate matter are discussed in Section III.A.4.a(3).

III.A.4.b(7)(b) Bottom Sediments

In the 1993 Cook Inlet study (UAA, ENRI, 1995), replicate sediment samples were taken at 15 of 16 stations and the mean metal concentration ranges in the sediments are shown in Table III.A-19. The mean concentration range across Cook Inlet is quite similar. These concentrations also are quite similar to the mean concentrations of metals found in sediments throughout the world. For antimony, arsenic, mercury, and zinc, the concentrations generally are lower that the lowest concentration of contaminates that adversely affect some marine organisms, as indicated by the Effects Range-Low values (Boehm, 1998); Effects Range-Low values represent the lowest concentrations of contaminants that adversely affect some marine organisms. The samples with mercury concentrations greater than the Effects Range-Low value of 0.13 micrograms per gram were from stations in both upper and lower Cook Inlet.

A more detailed trace metal survey in sediments was conducted in the 1997-1998 outermost Cook Inlet and Shelikof Strait Sediment Quality Study (Boehm, 2001a) (See Table III.A-20). No contamination from existing anthropogenic loading, including from oil industry, was found. This study did find elevated mercury concentrations in Kachemak Bay. However, concentrations of mercury in this surface sediment were similar to values observed in dated sediments, deposited over the last century. This indicates a local, natural mercury source. Accumulation rates and concentrations of metals have not increased anywhere in the study area since oil industry began in Cook Inlet.

Most metals entering the Cook Inlet system or being deposited in Kamishak Bay and Shelikof Strait are from the following upper Cook Inlet rivers: the Susitna, Matanuska, and Knik rivers (Boehm, 2001a). The loading of metals from these rivers is much higher than any anthropogenic loading to Cook Inlet and completely masks and any industrial sources of metals. Again, the southeastern part of Cook Inlet, the outer part of Kachemak Bay, and the Kennedy and Stevenson Entrances are exceptions with an additional source of suspended particulate matter being the Copper River (Feely et al., 1981; Boehm, 2001a).

III.A.4.b(7)(c) Benthic Biota

The concentrations of metals in mussel tissues from six Cook Inlet locations are shown in Table III.A-21. The highest concentrations of metals in the mussel tissues generally were found in the mussels from Chinitna Bay. The concentrations of the trace metals in the mussel tissues are variable and comparable with those obtained in past studies in Cook Inlet, Gulf of Alaska, and the Beaufort Sea; no anomalous trends were evident (UAA, ENRI, 1995).

III.A.4.c. Summary

The water quality of lower Cook Inlet generally is good. Cook Inlet is a relatively large tidal estuary with a sizable tidal range. The turbulence associated with mainly tidal currents but also winds results in the vertical mixing of the waters. A relatively large volume of waters and a large variety of naturally occurring inorganic and organic substances are transported into Cook Inlet by the streams and rivers and by currents from the Gulf of Alaska; the amounts of the individual substances discharged into the inlet appear to be quite variable. Substances transported into Cook Inlet that remain in suspension or dissolved in the water column are dispersed by tidal currents and winds. In addition, there are a variety of manmade substances routinely discharged into Cook Inlet. The major discharges are from municipalities bordering Cook Inlet, the oil and gas industry, and seafood processors. The quantities of manmade substances discharged into Cook Inlet generally are less than discharged by the streams and rivers. For some of the manmade substances, the amounts discharged may be within the range associated with the natural variability of stream and river discharges. In addition to the routine discharges, there have been a number of accidental spills of a variety of substances, including crude oil and refined petroleum products. Hydrocarbons are found throughout the marine environment, but generally the concentrations are low and of biogenic origin—mainly derived from terrestrial plants. The low concentrations of hydrocarbons in Cook Inlet are similar to concentrations found in other unpolluted coastal areas. The amount of total organic carbon in the sediments, where contaminants could accumulate, is low and indicates an environment that generally is uncontaminated.

III.A.5. Air Quality

The existing onshore air quality adjacent to the Cook Inlet multiple-sale area is superior to that set by the National Ambient Air Quality Standards and Alaska air-quality laws and regulations. Concentrations of regulated air-pollutant concentrations are far less than the maxima allowed. The Environmental Protection Agency calls this an attainment area because it meets the standards of the Clean Air Act. The Prevention of Significant Deterioration program of that Act places additional limitations on nitrogen dioxide, sulfur dioxide, coarse suspended-particulate matter 10 microns or less in diameter, and fine suspended-particulate matter 2.5 microns or less in aerodynamic diameter. Areas in Alaska currently are designated as Prevention of Significant Deterioration Class I or II. The Class I air-quality designation is the most restrictive and applies to certain national parks, monuments, and wilderness areas. Tuxedni National Wildlife Refuge is designated as a National Wilderness Area and is the only Class I area adjacent to the Cook Inlet multiple-sale area; the remaining area is designated Class II. Table III.A-22 lists the ambient air-quality standards for the program area.

Pollutants consist of scattered emissions, principally from population centers (area sources) and some industrial sources (point sources). The Environmental Protection Agency has published emissions summaries for many areas in Alaska. (The Alaska summary may be viewed at http://www.epa.gov/ttn/naaqs/ozone/areas/state/cnty/akcy.htm.) Industrial emissions (point sources) on the Kenai Peninsula primarily arise from gas processing, oil refining, power generation, and petrochemical production. Other emissions result from motor vehicles (highway and off-highway activities) (mobile sources). Vessel traffic in Cook Inlet also is a significant source of emissions. In Anchorage, the largest emissions are attributed to motor vehicles. Off-highway vehicular sources also contribute a significant fraction of the total emissions. Industrial sources consist mainly of power generation and refuse burning.

Air quality monitoring is confined mostly to population centers such as Anchorage, but an Environmental Protection Agency-approved air monitor was established in late 2001 at Tuxedni Bay to monitor air quality for the Class I air shed at Tuxedni National Wildlife Refuge; it is described at http://vista.cira.colostate.edu/improve. Measurements have shown that pollutant levels are well within the ambient air quality standards. The 8-hour average concentration of carbon monoxide in Anchorage violated the ambient standard once in 1996. The standard was exceeded once in 2001, but no violation occurred. The standard must be exceeded more than once in one year for a violation to occur.

III.B. BIOLOGICAL RESOURCES

III.B.1. Lower Trophic-Level Organisms

This section describes the lower trophic-level organisms in the planktonic habitats of lower Cook Inlet and those organisms in the corresponding benthic and intertidal habitats. Lower trophic-level animals are primarily invertebrates, a few of which are commercially important (for example, shrimp, crabs, and clams). Recent information on these commercially important invertebrates in Cook Inlet is summarized in a State of Alaska, Department of Fish and Game web site (http://www.state.ak.us/adfg/notebook/notehome.htm).

III.B.1.a. Planktonic Habitats

The Cook Inlet Sale 149 EIS includes important information on both phytoplanktonic and zooplanktonic organisms (USDOI, MMS, Alaska OCS Region, 1995:Section III.B.1.a). For example, it notes that "annual primary production for inside waters ranges between 100 and 300 'g C m^{-2}' and that annual zooplankton production in coastal waters probably is 10% to 20% of this, or '10 to 60 g C m^{-2}' (USDOI, MMS, Alaska OCS Region, 1995:III.B-1). It also notes that "upper Cook Inlet is strongly affected by sediment loading…due to the silt-laden freshwater that enters upper Cook Inlet" and that "the shading caused by this suspended material is believed responsible for the reduced utilization of surface nitrate during the spring…" (USDOI, MMS, Alaska OCS Region, 1995:III-B-1). The distribution of turbid water is illustrated in Figure III.B-1 as black areas because the suspended material interferes with the SeaWiFS satellite sensor of phytoplankton chlorophyll. The Sale 149 EIS notes further that the Alaska Coastal Current "…and a small portion of the Alaska Current (located farther offshore) enter lower Cook Inlet at Kennedy Entrance, encounter lower Cook Inlet currents, and combine to flow southwest through Shelikof Strait" and that "as they enter lower Cook Inlet, they create a summer-long upwelling condition…resulting in a probable vertical mixing of nutrients in that area." The Sale 149 description is incorporated by reference and updated with the following information.

Several recent studies were performed on the seasonal cycle in the planktonic food web in shallow-water nursery areas for juvenile herring and salmon in adjacent Prince William Sound (Norcross et al., 2001; Eslinger et al., 2001; Incze, Siefer, and Napp, 1997; Willette et al., 2001; Foy and Norcross, 1999). Norcross et al. (2001) studied the species that are transported into coastal regions from the Gulf of Alaska, and they determined that water transported into Prince William Sound from the Gulf of Alaska carried oceanic plankton into nearshore neritic habitats in the sound. The SeaWiFS image of phytoplankton chlorophyll distribution (Figure III.B-1) shows the effects of similar water and nutrient transport from the Gulf of Alaska into lower Cook Inlet during early June 2001. The inflow of oceanic water into Cook Inlet probably carries nutrients and oceanic species into neritic (nearshore) habitats in the lower inlet and Shelikof Strait. Recent studies have shown that SeaWiFS data on chlorophyll correspond with airborne measurements of phytoplankton productivity in Cook Inlet and the Gulf of Alaska (Brown et al., 2002), and have documented the seasonal cycle and interannual variability of nutrient supply, phytoplankton chlorophyll and productivity in shelf waters of the Northern Gulf of Alaska (Childers et al., 2002).

Eslinger et al. (2001) studied the temporal variability in phytoplankton biomass. They concluded that the primary environmental reasons for the variability appeared to be nutrient concentrations and possibly water currents. The importance of nutrient-rich currents in lower Cook Inlet can be seen in the satellite image of the distribution of phytoplankton biomass, as measured by chlorophyll—a concentration (Figure III.B.-1). The top edge of the image shows high chlorophyll concentrations (red/orange colors) in the northern part of the proposed lease area where water is mixed in the tidal rips between the Forelands. High concentrations are shown also in the lower half of the proposed lease area where water flows northwest through the narrow Kennedy and Stevenson Entrances from the Alaska Coastal Current in the Gulf of Alaska. The chlorophyll concentrations are lower (blue/green colors) in the central part of lower Cook Inlet, in Kamishak Bay, along the western edge of the proposed lease area, and in the central and southern parts of Shelikof Strait.

Eslinger et al. (2001) also described two types of spring phytoplankton blooms in Prince William Sound. During springs in which early, strong physical stratification developed, the phytoplankton blooms tended to be intense and short-lived. During springs in which slower, weaker stratification developed, the phytoplankton blooms tended to be prolonged and took longer to peak. The slower blooms led to prolonged periods of phytoplankton production, prolonged interaction with the springtime grazing of copepods and other zooplankters, and the incorporation of more organic matter into pelagic food webs. The latter condition was observed during 1994 and 1995 when the springs were relatively cold and stormy and the water column was mixed more deeply. The typical conditions in Cook Inlet, which has strong tidal mixing, are probably similar to the prolonged spring blooms in Prince William Sound. In Shelikof Strait, the springtime bloom is very strong; Incze, Siefer, and Napp (1997) found that the springtime biomass of copepods exceeds reported values from Cook Inlet and is not unlike biomass values from the southeastern Bering Sea during some years.

Willette et al. (2001) created a computer model that simulated the multiyear patterns of plankton blooms and salmon survival in Prince William Sound. The model included data on six key zooplankton taxonomic groups and two categories of adult pelagic fishes. Their data indicates that juvenile fishes preyed on large copepods at high concentrations but that the fishes switched to other prey as the biomass of large copepods declined. The switch in prey coincided with the dispersal of juvenile salmon from nearshore habitats and a five-fold increase in predation. Copepods are usually a dominant species in the planktonic food web and during some years they are an especially important prey for juvenile herring (Foy and Norcross, 1999).

The planktonic community occasionally shifts between two different types of food webs (Anderson and Piatt, 1999). In one food web, a pandalid shimp is a key species, and the food web tends to support the growth of short-lived fish such as eulachon and capelin. The other food web favors the growth of long-lived fishes such as gadids. Ongoing research for the *Exxon Valdez* Oil Spill Trust and the NOAA Steller sea lion program includes further analyses of these community or regime shifts, including research by scientists at the U.S. Geological Survey's Alaska Science Center and NMFS Alaska Fisheries Science Center.

The computer model mentioned above (Willette et al., 2001) includes estimates of annual primary production, the maximum grazing rate of zooplankton on phytoplankton (0.005% of the phytoplankton per hour), and the maximum natural mortality rate of zooplankton (0.06% of the zooplankton per day). The annual primary production is similar to the estimated range of 100-300 grams carbon per meter squared per year described in the Sale 149 EIS (USDOI, MMS, Alaska OCS Region, 1995:III.B-1). The maximum grazing rate on phytoplankton indicates that the populations replace themselves (i.e., the total biomass doubling or turnover time) in about 4 days, and the maximum mortality rate of zooplankton indicates that the populations replace themselves in about 16 days. These estimates are similar to the standard turnover times in textbooks for temperate, eutrophic coastal waters (Lalli and Parsons, 1997:135 and Table 3.3).

Finally, some recent studies of natural hydrocarbons in lower Cook Inlet benthic biota, including algae, sea urchins, limpets, snails, and the mussel *Mytilus*, and of the background toxicity of sediments to the amphipod Amplisca and the clam Macoma, are summarized in water-quality section (Section

III.A.4.b(6)(b)2)a)). The section explains that sublethal toxicity was detected near the Bluff Point coal beds and in the Homer Spit boat basin.

In summary, the new information on lower trophic-level organisms, and especially copepods, indicates that they are important prey in shallow-water fish-nursery areas. It indicates also that the coastal phytoplankton and zooplankton populations are capable of doubling their respective biomass in a few days and a couple weeks, respectively.

III.B.1.b. Benthic and Intertidal Habitats

The Sale 149 EIS includes a comprehensive description of the organisms in both the deep-subtidal habitats and in shallow-subtidal/intertidal habitats of Cook Inlet (USDOI, MMS, Alaska OCS Region, 1995:Section III.B-1.b). Aside from the former EIS description, a book entitled *The Gulf of Alaska, Physical Environment and Biological Resources* includes an extensive summary of information on the subtidal benthos in Cook Inlet (Feder and Jewett, 1986).

III.B.1.b(1) Deep-subtidal Communities

The Sale 149 EIS includes a comprehensive description of the deep-subtidal communities, including information on both the infauna and epifauna (USDOI, MMS, Alaska OCS Region, 1995:Section III.B-1.b.2). With respect to infauna, it notes that: "In the Kachemak Bay area, Driskell and Lees…have identified five subtidal areas consisting of four substrate types (rock, sand, silt, and shell debris) and their respective infaunal assemblages" and notes that the "…infaunal assemblage located in a shell-debris area accounted for over 80 percent of the total species…." It also notes that "…subtidal infaunal organisms (particularly bivalve mollusks) are important trophic links for crabs, flatfishes, and other organisms that are common in lower Cook Inlet…."

With regard to epifauna, the Sale 149 EIS notes that:

> This group of organisms consists primarily of shellfish (crustaceans)…. King crabs occurred year-round in Kachemak and Kamishak Bay…. King-crabs in the Kamishak Bay area were found to predominately feed on barnacles (81%), bivalves (13%), and hermit crabs (12%). King crabs samples in the Augustine Island area also were found to feed heavily on barnacles…. The southern portion of lower Cook Inlet (including Kachemak Bay) also supports the three numerically important species of pandalid shrimp…. These species were observed to feed predominately on diatoms, polychaetes, bivalves, and crustaceans…. They in turn are fed upon by tanner crabs (Paul, Feder, and Jewett, 1979) and bottom-feeding fishes (Feder et al., 1981).

The information on infauna and epifuana organisms in the Sale 149 EIS is incorporated by reference. These species form an essential part of the food web for the other species described in this assessment. For example, the species consumed by sea otters includes bivalves, gastropods, decapods, isopods, echinoderms, annelids, and kelp (Section III.B.4.b(9)(a-d).

III.B.1.b(2) Shallow-subtidal/intertidal Communities

The Sale 149 EIS includes an excellent description of the shallow-subtidal/intertidal communities, the infauna and epifauna of lower Cook Inlet (USDOI, MMS, Alaska OCS Region, 1995:Section III.B-1.b.(1)). With respect to intertidal/shallow subtidal habitats, the Sale 149 EIS notes that "…the intertidal and shallow subtidal communities in the lower Cook Inlet area were evaluated by Lees et al. (1986)"; that "…in western lower Cook Inlet, these communities were found to be strongly influenced by the effects of seasonal ice and exhibited strong affinities to those of the Bering and Beaufort Seas"; and that "…in eastern lower Cook Inlet (ice free), these communities were similar to those of southeastern Alaska, British Columbia, and Washington" (USDOI, MMS, Alaska OCS Region, 1995:Section III.B.1.b). It also notes that "…the rocky intertidal and shallow subtidal floral communities in southwestern lower Cook Inlet were dominated by the brown algae *Fucus* and ephemeral red algae (mainly *Rhodymenia* spp.)" (USDOI, MMS, Alaska OCS Region, 1995:Section III.B.1.b). It notes further that "…kelps dominated the low intertidal areas out to about 3 meters in depth but were absent below about 5 meters" and that "the movement of winter ice was suggested as a possible cause for the lack of seaweeds within the midtidal zone."

The Sale 149 EIS also notes that:

> The deeper sands were dominated by razor clams (*Siliqua patula*), which comprise the greatest percentage of the biomass on sandy beaches in the lower Cook Inlet and Shelikof Strait…. Muddy beaches were typically dominated by clams (for example, *Myra* spp. and *Macoma balthica*)…. Use of faunal resources on muddy beaches by birds and fish may be high in spring, when birds are migrating north and salmon smolts are outmigrating from streams. Several species of crab and other fish also feed on mudflat organisms during spring and summer months.

This Sale 149 EIS information on shallow-subtidal/intertidal habitats is incorporated by reference and expanded with the following information.

As noted, the west side of Cook Inlet is inhabited by many "arctic type" species that have not been found elsewhere on Gulf of Alaska shorelines. A very good description of the arctic fauna and flora is contained in Attachment A to a letter from the Cook Inlet Regional Citizens Advisory Council (in the appendix on Review and Analysis of Comments Received). The attachment explains that the geographic isolation of the arctic-type organisms might have lead to some genetic distinction. The clams on the extensive mudflats on the west side are very important to migrating and wintering shorebirds and sea ducks, as described by Bennett (1996) and noted in Section III.B.5.b on the food sources of marine and coastal birds. The same environmental factors that have favored arctic-type species on the west side (for example, cold water and sea ice) probably have eliminated other species, such as the kelp that grows in Kachemak Bay.

Aside from the biological and ecological characterization of lower trophic-level organisms, some of the species are important for commercial and subsistence reasons. Subsistence is conducted mainly around rural Cook Inlet villages and communities. In some localities, lower trophic-level organisms are harvested, as described in Section III.C. For example, the black chiton, *Katharina tunicata*, is an important subsistence food source for some Native communities on the Kenai Peninsula. The lower trophic-level organisms that are harvested commercially are described in Sections III.C.2.a and IV.B.1.k(3)(a)) on commercial shellfish fisheries. The species include crabs, shrimp, scallops, and clams. Additional information on the commercial effects of toxic plankton blooms in the proposed sale area is included in a National Oceanic and Atmospheric Administration (NOAA) web site (www.nwfsc.noaa.gov/hab).

The overall environmental sensitivity of Cook Inlet shorelines has been ranked by several indicies. The indices and information on habitat-recovery rates are important to the following assessments (Section IV.B.1.c) and are described in detail. The following is information on an environmental sensitivity index in the Alaska Regional Response Team (ARRT) Cook Inlet Subarea Contingency Plan (www.akrrt.org/CIplan/CItoc.shtml). The plan, which was updated in July 1997 by Cook Inlet Spill Prevention and Response, Inc., includes information on biologically sensitive areas in the intertidal zone and shoreline habitats. The reason for the exclusion of benthic habitats is that, as stated, "…oil vulnerability is lower in benthic areas than in the intertidal zone since contamination by floating slicks is unlikely" (Alaska Regional Response Team, 1997:D-30). In general, the vulnerability of shoreline habitats is rated as low, if the shoreline substrate is impermeable (rock) and exposed to high wave energy or tidal currents. The vulnerability is rated as high for vegetated wetlands such as marshes and swamps with high coverage of organisms. Also, the vulnerability is rated as high for semipermeable substrates (mud) that are sheltered from wave energy and strong tidal currents.

The environmental sensitivity indices described identify a few cases or sections of the coastline that are sensitive primarily because of lower trophic-level organisms. Those cases, or sensitive areas, are listed in the following from south to north with the corresponding ARRT site number and MMS Oil Spill Trajectory Model Land Segment (LS) numbers (Map A-3). The list includes details about the reason for the environmental sensitivity that relates to lower trophic-level organisms (for example, the presence of marshes or clams):

- Kachemak Bay (ARRT #53, LS 47) is identified as very sensitive partly because of the concentrations of razor clams. Littleneck clams also are harvested in Kachemak Bay, according to a NOAA web site (www.nwfsc.noaa.gov/hab.newsletter/HAB_impacts_Alaska.htm).
- Clam Gulch (ARRT #52, LS 43) is identified as very sensitive partly because of the concentrations of razor clams.
- Kalgin Island (ARRT #45, LS 38) is identified as very sensitive partly because of razor clam concentrations on the south end of the island.

The NOAA also has prepared a chart that identifies four sensitive shoreline habitats in lower Cook Inlet (U.S. Dept. of Commerce [USDOC], National Oceanic and Atmospheric Administration, 1994). The four include marshes, sheltered tidal flats, sheltered rocky shores, and exposed tidal flats. Marshes are considered very sensitive "…because of their high biological utilization and value, difficulty of cleanup, and potential for long-term impacts to both the habitat and the organisms which rely upon it." Sheltered tidal flats are considered sensitive because "…the high biological utilization, soft substrate, and low-energy setting make these habitats highly sensitive to oil-spill impacts and almost impossible to clean." Sheltered rocky shores are considered sensitive because "…fractures will be sites of pooling and long-term persistence of oil" and because "…cleanup can be intrusive, usually requiring flushing techniques." Exposed tidal flats are considered sensitive because "…cleanup is always difficult because of the potential for mixing oil deeper into the sediments."

The NOAA chart illustrates the location of these four types of sensitive shoreline habitats in lower Cook Inlet. One type or another extends along almost the entire shoreline from Nanwalek (English Bay) to the Kenai River on the east side of lower Cook Inlet. On the west side of the inlet, the sensitive habitats exist across the south and southwest parts of Kamishak Bay; in the backs of the bays on the west and north sides of Kamishak Bay; and from Chinitna Bay north through the West Forelands.

A third sensitivity index on Cook Inlet shoreline is being prepared for the *Exxon Valdez* Oil Spill Trustees and Cook Inlet Regional Citizens Advisory Council. Some of the biophysical coastal habitat maps that have been prepared are available online (http://imf.geocortex.net/mapping/demos/cori/launch.html). The maps include data on shoreline type, sediment, coastal stability, eelgrass, kelp and marsh as well as derivative data such as oil-spill sensitivity and fish-spawning potential.

New information is available on the recovery rate of lower trophic-level organisms in intertidal habitats. The information is for the recovery rate of organisms on sheltered rocky shores in lower Cook Inlet (Highsmith, Saupe, and Blanchard, 2001). In this study, several sites were cleared of all algae and invertebrates, monitored for organism abundance or percent cover, and compared with control sites. Recolonization of the kelp *Alaria* spp. followed recruitment of the barnacle, but neither had recolonized to control levels by the end of the 2½ year study. The study concludes that 5-10 years would be needed to document full recolonization.

In summary, the subtidal and intertidal/shallow subtidal habitats in lower Cook Inlet are considered very sensitive environmentally partly because of the concentrations of lower trophic-level organisms and partly because of their vulnerability to floating oil slicks. The sensitive habitats extend around most of lower Cook Inlet, and recolonization of some would require about a decade. The specific risks to these habitats and effects on them are assessed in Section IV.B.1.c.

III.B.2. Fisheries Resources

The U.S. Congress concluded in the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (Public Law [P.L.] 94-265) that the fish off the coasts of the United States, the highly migratory species of the high seas, the species that dwell on or in the Continental Shelf of the United States (U.S.), and the anadromous species that spawn in U.S. rivers or estuaries, constitute valuable and renewable natural resources. These fishery resources contribute to the food supply, economy, and health of the Nation and provide recreational opportunities. The MSA defines "fish" to mean finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds. The term "fishery resource" means any fishery, any stock of fish, any species of fish, and any habitat of fish. This section discusses representative "fish" species (as defined by the MSA) found in the Cook Inlet, Kodiak, and South Alaskan Peninsula regions. Our analysis relies on population-level impacts; our definition of a population is defined here as a group of organisms of one species, occupying a defined area (the central Gulf of Alaska, which includes the South Alaskan Peninsula, Kodiak Archipelago, Shelikof Strait, Cook Inlet, and Prince William Sound regions) and usually isolated to some degree from other similar groups. A "stock" is defined here as a subpopulation of the area's population. The descriptions emphasize aspects of the morphology and life history of these species that the Proposed Action might influence. Additionally, many species described herein have subsistence-, commercial-, and sport-fishing values.

Although Essential Fish Habitat is discussed in Section III.B.3, the reader may find Maps 3 through 10 and 21 of use concerning the distribution of fishes accounted for in the following.

III.B.2.a. Pelagic Fishes

Pelagic fishes usually inhabit the water layers above the abyssal zone (waters below 4,000 meters) and beyond the littoral zone (nearshore zone between high- and low-water marks). Many of these finfishes migrate long distances in response to changing environmental conditions for food or reproduction. Some pelagic fish segregate by cohort or life-history stage and use different habitat areas during these different life stages. For example, while some adults may enter Cook Inlet during a particular year (for example, 2004) to spawn after spending years at sea in the North Pacific Ocean, other members of the same population continue to reside at sea and may not enter Cook Inlet for a year or more (for example, 2005, 2006).

III.B.2.a(1) Pacific Herring (*Clupea pallasi*)

This comparatively small fish occurs in large schools in the Cook Inlet region in early April and possibly through early fall. The Pacific herring is one of more than 180 species in the herring family *Clupeidae*. Herring are important prey for a wide variety of fishes, mammals, and birds. Pacific herring migrate in schools and are found along both shores of the North Pacific Ocean, ranging from San Diego Bay to the Bering Sea and Japan. Herring have a blue-green upper body with silvery sides and lack markings. The body is laterally compressed, and the scales along the underside project in a slightly serrated arrangement. Scales are large and easily removed. These fish may grow to 46 centimeters (18 inches) in length, but a 23-centimeter (9-inch) specimen is considered large.

Pacific herring generally spawn during the spring. In Alaska, spawning first occurs in the southeastern archipelago during mid-March, in Prince William Sound in April and May, and in the Bering Sea during May and June. Spawning is confined to shallow, vegetated areas in intertidal and subtidal zones. Eggs are adhesive, and survival is better for those eggs that stick to intertidal vegetation than for those that fall to the bottom. Milt released by males drifts among eggs and fertilizes them. Eggs hatch in about 2 weeks, depending on water temperature. Herring are iteroparous, spawning every year after reaching sexual maturity at 3 or 4 years of age. The number of eggs spawned varies with the age of the female, averaging 20,000 annually. Average lifespan for these fish is about 8 years in Southeast Alaska and up to 16 years in the Bering Sea. Egg mortaility is high. Young larvae drift and weakly swim with ocean currents and are preyed on extensively by other vertebrate and invertebrate fauna. Following metamorphosis of larvae to the juvenile form, they rear in sheltered bays and inlets and appear to remain segregated from adult populations until they mature. In the Cook Inlet region, herring usually first spawn in their second year and may continue to spawn annually for up to 15 years. Herring spawn extensively along much of the Shelikof coastline of Kodiak Island and the South Alaska Peninsula, areas that might be affected by the Proposed Action. Kamishak Bay is one major spawning area that supports a short-season sac-roe fishery.

Herring inhabit distinctly different habitat areas during different periods of the year. After spawning, most adults leave inshore waters and move seaward to feed primarily on zooplankton such as copepods and other crustaceans. They are seasonal feeders and accumulate fat reserves for periods of relative inactivity. Herring schools often follow a diel vertical migration pattern, spending daylight hours near the bottom and moving upward during the evening to feed (http://www.state.ak.us/adfg/notebook/fish/herring.htm).

III.B.2.a(2) Pacific sand lance (*Ammodytes hexapterus*)

The Pacific sand lance occurs throughout coastal marine waters of Alaska (Mecklenburg, Mecklenburg, and Thorsteinson, 2002). Their range includes the Bering Sea and eastern North Pacific Ocean. Information reported in the following is from Robards et al. (1999).

Physical characteristics of the sand lance include an elongate and compressed body with diagonal skin folds, a fleshy ridge extending the length of the body on either side of the ventral midline, a single dorsal fin that folds back into a groove, and a projecting lower jaw. The dorsal and anal fins are supported by soft rays only. Sand lance are metallic blue in color dorsally and silver ventrally. Sand lance generally grow to

20 centimeters (8 inches) or less in length; however, individuals in the Bering Sea grow larger, up to 28 centimeters (11 inches) in length.

Sand lance are abundant in shallow, nearshore areas ranging in depth to 100 meters (55 fathoms), but they are most common at depths less than 50 meters (27 fathoms) and often in as little as 6 meters (3 fathoms). This shallow distribution probably results from their preference for light and accessibility of prey.

Sand lance are a quintessential forage fish, and as a group (there are six species worldwide) are possibly the single most important taxon of forage fish in the Northern Hemisphere. Sand lance are preyed on by numerous species of seabird, marine mammal, and fish, in addition to various land birds and animals. Population fluctuations and distribution of predators are frequently linked to sand lance abundance. Sand lance also play an important role in the ecosystem as a consumer of zooplankton.

Juvenile and adult sand lance exhibit the rather unusual habit of alternating between lying buried in the substrate and swimming in well-formed schools. They typically are associated with fine gravel and sandy substrates up to and including the intertidal zone. Their use of substrates appears to be highly specific. In the natural environment, substrates used by sand lance have been characterized consistently as well washed, drained, and unpacked and typically contain coarse sands with little or no mud and silt. Sand lance also avoid oil-contaminated sediments. Although wide ranging, their preference for specific shallow substrates results in a patchy distribution of groups. Sand lance bury themselves within the substrates during periods of low light, during estivation (i.e., passing hot periods in torpor) and dormant periods, or occasionally in response to predators.

Most investigators have reported that sand lance are abundant in preferred habitats from spring to late summer and uncommon during the remainder of the year. Sand lance rarely are caught in the water column during the winter months and appear to remain inactive or in hibernation while buried in intertidal and shallow subtidal lands. If disturbed during winter on extreme low tides, however, they can move spontaneously and quickly. Juvenile sand lance are caught occasionally in beach seines during the winter, but they normally are found buried in substrates with adults.

Feeding occurs primarily in the water column, although epibenthic invertebrates occasionally appear in the diet. Several researchers have shown that for sand lance, vision is far more important than olfaction in feeding. Feeding habits of sand lance change with age. Larvae feed on phytoplankton, diatoms, and dinoflagellates; once juveniles reach 10 millimeters (less than 1 inch), they feed on nauplii of copepods in summer and euphausiids in winter. Adult fish prey on macrocopepods, chaetognatha, and fish larvae. Overall, copepods are the predominant prey source for postlarval stages. Other prey reported from diets include crustacea, amphipoda, isopod larvae, mysids, gammarid amphipods, harpacticoid copepods, larvaceans, annelids, polychaetes, juvenile bivalves and gastropods, insect flotsam, fish larvae, and invertebrate and fish eggs.

Sand lance typically reach maturity in their second year, although a few individuals remain immature for longer periods. Spawning occurs in late September and October on fine gravel and sandy beaches, soon after summer water temperatures begin to decline. Sand lance approach intertidal sites where spawning sometimes has taken place for decades. Spawning takes place in dense formations. Female sand lance burrow through the substrate while releasing eggs, which results in the formation of scour pits in intertidal sediments. Females are reported to release 1,468-16,081 eggs. Eggs are deposited in the intertidal zone just below the water line. Larvae hatch at a size of approximately 5 millimeters (less than 1 inch) before the spring plankton bloom.

III.B.2.a(3) Eulachon/Candlefish/Hooligan (*Thaleichthys pacificus*)

The eulachon is one of five species of smelt (family *Osmeridae*) found in Alaska. The name is derived from the Chinook language of the Pacific Northwest Native peoples and has several variations, of which hooligan is the most commonly used in Alaska. The eulachon, a very oily fish, also is known as the candlefish because of its traditional use as a candle when dried and fitted with a wick. The genus name, *Thaleichthys*, is Greek for rich fish, which lends to the eulachon's reputation as having flesh of a high oil content.

The eulachon is a small fish up to 10 inches in total length. The front of the eulachon's dorsal fin begins well behind where its pelvic fin is attached to its body, and its gill covers have circular grooves, which distinguishes it from other Alaska fishes. Young eulachon have moderately developed canine-like teeth that they lose as they mature; by spawning time, the eulachon usually has no teeth. Eulachon generally are blue-silver in color turning to gray-brown at spawning time, when the males are easily distinguished from the females by tubercles on the head and on the scales along the lateral line, more musculature development along the lateral line, and longer paired pectoral and pelvic fins.

Eulachon are anadromous, spawning and hatching in freshwater. They grow to maturity in the ocean where, as juveniles and adults, they feed mainly on euphasids, a small shrimplike crustacean sometimes called krill. As the spawning season approaches, eulachon gather in large schools off the mouths of spawning streams and rivers. The upstream migration is closely keyed to the water temperature of the stream. In Southeast Alaska, the migration can occur as early as April; while in central and western Alaska, it generally takes place in May. Eulachon move nearshore in early May and spawn in drainages throughout Cook Inlet. Some streams have two separate but overlapping migrations. Males usually outnumber the females during the spawning migration. Eulachon generally spawn in the lower reaches of the river or stream. After spawning, the majority of the eulachon die. Eggs are broadcast over sandy gravel bottoms where they attach to particles of sand and hatch in 21-40 days, depending on the water temperature. Depending on size, egg complements range from 17,300-39,600 per fish, averaging about 25,000 eggs. Newly hatched young are carried by currents to the sea (Hart, 1973), where they feed mainly on copepod larvae and other plankton. After 3-4 years at sea, they return as adults to spawn.

In Alaska, eulachon are seasonally abundant in most major watershed drainages from the Southeast west to Cook Inlet and become less abundant westward out to the Aleutian Islands and to the Pribilof Islands in the Bering Sea. Some drainages with eulachon migrations include the Unik (Eulachon), Stikine, Taku, Mendenhall, and Chilkat rivers in Southeast; the Situk River near Yakutat; the Copper River Delta area near Cordova; and the Kenai, Susitna, and Twentymile rivers in Cook Inlet. Eulachon also are present in many smaller streams with varying abundance. In the westward margins of their range, eulachon are displaced by a similar-appearing smelt, the rainbow smelt (*Osmerus mordax* [Mitchill]).

Eulachon are important forage fish. Newly hatched and juvenile eulachon are prey for a variety of larger marine fishes, such as salmon. Marine mammals including seals, sea lions, and beluga whales also feed on them in abundance when the eulachon gather off the mouths of their spawning streams. Spawning eulachon and spent bodies of spawned-out eulachon are eaten by gulls, eagles, and bears and by the white and green sturgeon in the larger rivers of Southeast Alaska, British Columbia, and the Pacific Northwest. The spent bodies of spawned-out eulachon also contribute to the nutrient cycle as they decompose (http://www.state.ak.us/adfg/notebook/fish/eulachon.htm).

III.B.2.a(4) Capelin (*Mallotus villosus* [Muller])

The capelin is a major forage fish of the Cook Inlet region. A small fish (mature specimens are generally 13-20 centimeters [5-8 inches] long) but like salmon, the capelin is classified within the family *Osmeridae* (along with smelts). Populations of capelin are large and range extensively over Alaskan waters, generally inhabiting pelagic waters. Capelin mainly are filter feeders, thriving on planktonic organisms such as euphausiids and copepods.

Capelin spawn on beaches and in deeper waters and are highly specific regarding spawning conditions. Temperature, tide, and light conditions are primary criteria for successful spawning; most spawning takes place at night or in dull, cloudy weather. On the Pacific coast of Canada, capelin spawn on gravelly beaches in various localities in the Strait of Georgia during late September or October. Capelin also spawn in the southwestern Bering Sea in May, and spawning capelin have been harvested from Bristol Bay at about the same time. Capelin eggs attach to beach and bottom gravels. Depending on temperature, hatching ranges from 15-55 days. Most capelin die after spawning. Currently, capelin have no economic value to Alaska; however, the species is used extensively for food by other fishes, marine mammals, and seabirds.

III.B.2a(5) Salmonids

The Cook Inlet region is a migratory corridor and early-life rearing area for all five species of Pacific salmon and for Dolly Varden and steelhead trout. These anadromous fishes transit much of the area, including Shelikof Strait, as smolt leaving natal (home) freshwater drainages and again later as returning adult spawners. Juvenile salmonids from Prince William Sound following ocean currents also probably transit much of Shelikof Strait and also may enter Cook Inlet. Salmon in the Cook Inlet, Kodiak, and South Aleutian Peninsula regions afford a high value to the commercial-fishing industry.

III.B.2.a(5)(a) Pink Salmon (Oncorhynchus gorbuscha)

The pink salmon also is known as the “humpback” or “humpy” because of the pronounced, laterally flattened hump that develops on the backs of adult males before spawning. It is native to Pacific and arctic coastal waters from northern California to the Mackenzie River, Canada; and to the west from the Lena River in Siberia to Korea.

The pink salmon is the smallest of the Pacific salmon found in North America, with an average weight of about 1.5-1.8 kilograms (3.5-4 pounds) and average length of 51-63 centimeters (20-25 inches). An adult fish returning to coastal waters is bright steely blue on top and silvery on the sides with many large black spots on the back and entire tailfin. Its scales are very small and the flesh is pink. As the fish approaches the spawning streams, the bright appearance of the male is replaced by brown to black above with a white belly; females become olive green with dusky bars or patches above and a light-colored belly. By the time the male enters the spawning stream, it has developed the characteristic hump and hooked jaws. Juvenile pink salmon are silvery, without the dark vertical bars, or parr marks, of the young of other salmon species.

Adult pink salmon enter Alaskan spawning streams between late June and mid-October. Different races or runs with differing spawning times frequently occur in adjacent streams or even within the same stream. Most pink salmon spawn within a few miles of the coast, and spawning within the intertidal zone or the mouth of streams is very common. Shallow riffles where flowing water breaks over coarse gravel or cobble-size rock and the downstream ends of pools are favored spawning areas. The female pink salmon carries 1,500-2,000 eggs, depending on her size. She digs a nest, or redd, with her tail and releases her eggs into the nest. They are immediately fertilized by one or more males and then covered by further digging by the female. The process is commonly repeated several times until all the female’s eggs have been released. After spawning, both males and females die usually within 2 weeks.

Eggs hatch during early to midwinter. The alevins, or young fry, feed on the attached yolk-sac material early in their development. In late winter or spring, fry swim up out of the gravel and migrate downstream into saltwater. The emergence and emigration of fry is heaviest during hours of darkness and usually lasts several weeks.

Following entry into seawater, juvenile pink salmon move along beaches in dense schools near the surface, feeding on plankton, larval fishes, and occasionally on insects. Predation is intense on very small, newly emerged fry, but growth is rapid. By autumn, at an age of about 1 year, juvenile pink salmon are 10-15 centimeters (4-6 inches) long and move into offshore feeding grounds in the Gulf of Alaska and Aleutian Islands waters. High-seas tag-and-recapture experiments revealed that pink salmon originating from specific coastal areas have characteristic distributions at sea that are overlapping, nonrandom, and nearly identical from year to year. The ranges of Alaskan pink salmon at sea and pink salmon from Asia, British Columbia, and Washington overlap. Frequently, in a particular stream, the other odd-year or even-year cycle will predominate although in some streams both odd- and even-year pink salmon are about equally abundant. Cycle dominance occasionally will shift, and the previously weak cycle will become most abundant (http://www.state.ak.us/adfg/notebook/fish/pink.htm). Spawning pink salmon reach the Cook Inlet region annually in early July, where they spawn in most streams of this region. Pink salmon also sometimes spawn in the intertidal zone in some streams. Pink salmon rear in the North Pacific Ocean for two winters before returning to the Cook Inlet region to spawn and die. Pink salmon are seasonally distributed over most of this region from spring through early fall annually.

III.B.2.a(5)(b) Chum Salmon (O. keta)

This species ranges to 109 centimeters (43 inches) in length and up to 20.8 kilograms (46 pounds) in weight (Mecklenburg, Mecklenburg, and Thorsteinson, 2002). Chum salmon have the widest distribution of any Pacific salmonid. They range south to the Sacramento River in California and the island of Kyushu in the Sea of Japan. In the north, they range east in the Arctic Ocean to the Mackenzie River in Canada and west to the Lena River in Siberia. Chum salmon are the most abundant commercially harvested salmon species in Arctic, Northwestern, and Interior Alaska but are of relatively less importance in other areas of the State, where they are known locally as "dog salmon" and are a traditional source of dried fish for winter use.

Ocean-fresh chum salmon are metallic greenish-blue on the dorsal surface (top) with fine black speckles. They are challenging to distinguish from sockeye and coho salmon without examining their gills or caudal fin-scale patterns. Chum salmon have fewer but larger gillrakers than other salmon. After nearing freshwater, however, chum salmon change color; particularly noticeable are the vertical bars of green and purple, which lead them to be called by the common name, calico salmon. Males develop the typical hooked snout of Pacific salmon and very large teeth, which partially account for their also being called dog salmon. Females have a dark horizontal band along the lateral line; their green and purple vertical bars are not so obvious.

Chum salmon often spawn in small side channels and other areas of large rivers, where upwelling springs provide excellent conditions for egg survival. They also spawn in many of the same places as pink salmon—small streams and intertidal zones. Some chum salmon in the Yukon River travel more than 2,000 miles to spawn in the Yukon Territory. These have the brightest color and possess the highest oil content of any chum salmon beginning their upstream journey. Chum salmon spawning is typical of Pacific salmon, with eggs deposited in redds located primarily in upwelling spring areas of streams. Female chum may lay as many as 4,000 eggs, but fecundity typically ranges between 2,400 and 3,100 eggs. Chum salmon do not remain in freshwater after emerging as fry in contrast to chinook, coho, and sockeye salmon. Chum salmon are similar to pink salmon in this respect, except that chum fry do not move out into the ocean in the spring as quickly as pink fry. Chum fry feed on small insects in the stream and estuary before forming schools in saltwater, where their diet usually consists of zooplankton. By autumn, they emigrate into the Bering Sea or Gulf of Alaska where they spend one or more of the winters of their 3- to 6-year lives. In southeastern Alaska, most chum salmon mature at 4 years of age although there is considerable variation in age at maturity between streams. There also is a higher percentage of chum salmon in the northern areas of the State. Chum salmon vary in size from about 2-14 kilograms (4-30 pounds) but usually range from 3-8 kilograms (7-18 pounds), with females usually smaller than males (http://www.state.ak.us/adfg/notebook/fish/chum.htm). Chum salmon enter the Cook Inlet region beginning in early July, and the spawning runs continue through early August. Chum salmon spawn in many streams throughout the region, with eggs deposited in stream gravels. Fry subsequently move downstream to the ocean where they remain for three to four winters before returning to natal streams to spawn and die.

III.B.2.a(5)(c) Coho Salmon (O. kisutch)

The last of the Pacific salmon to return to the proposed sale area to spawn, coho salmon enter the region in late July, and runs continue until September. Coho salmon, also called silver salmon, are found in coastal waters of Alaska from Southeast to Point Hope on the Chukchi Sea and in the Yukon River to the Alaska-Yukon border. Coho are extremely adaptable and occur in nearly all accessible bodies of freshwater, from large transboundary watersheds to small tributaries.

Adults usually weigh approximately 3-5 kilograms (8-12 pounds) and are 61-76 centimeters (24-30 inches) long, but individuals weighing 14 kilograms (31 pounds) have been caught. Adults in seawater or newly arrived in freshwater are bright silver with small black spots on the back and on the upper lobe of the caudal fin. They can be distinguished from chinook salmon (*Oncorhynchus tshawytscha*) by the lack of black spots on the lower lobe of the tail and gray gums; chinook have small black spots on both caudal lobes and have black gums. Spawning adults of both sexes have dark backs and heads with maroon to reddish sides. Males develop a prominent hooked snout with large teeth called a "kype." Juvenile coho salmon have 8-12 parr marks evenly distributed above and below the lateral line, with parr marks narrower than the interspaces. The adipose fin is uniformly pigmented. The anal fin has a long leading edge usually tipped with white, and all fins are frequently tinted with orange.

Coho salmon enter spawning streams from July to November, usually during periods of high runoff. Run timing reflects the migratory obstacles encountered by some specific stocks. In some streams with barrier falls, adults arrive in July when the water is low and the falls are passable. In large rivers, adults must arrive early, as they need several weeks or months to reach headwater spawning grounds. Run timing also is regulated by water temperature at spawning grounds; where temperatures are low and eggs develop slowly, spawners demonstrate early run timing to compensate, and where temperatures are warm, adults are late spawners. Adults hold in pools until ripened and then move onto spawning grounds; spawning generally occurs at night. The female digs a redd and deposits 2,400-4,500 eggs. The male fertilizes eggs with sperm as they are deposited. The eggs develop during the winter and hatch in early spring. Embryos remain in the gravel, consuming their egg yolk for nutrition until emerging in May or June. The emergent fry occupy shallow aquatic margins and, as they grow, establish territories that they defend from other salmonids. They live in ponds, lakes, and pools in streams and rivers, usually among submerged woody debris—quiet areas free of current—from which they dart out to seize drifting insects.

During autumn, juvenile coho salmon may travel miles before locating off-channel habitat where they pass the winter free of floods. Some fish leave freshwater in the spring and rear in brackish estuarine ponds and then move back into freshwater in autumn. They spend one to three winters in streams and may spend up to five winters in lakes before emigrating to the sea as smolt. Their time at sea varies. Some males (called jacks) mature and return after only 6 months at sea at a length of about 30 centimeters (12 inches), while most fish stay 18 months at sea before returning to freshwater watersheds as full-sized adults.

Little is known of the oceanic movements of coho salmon. High-seas tagging shows that maturing Southeast Alaska coho move northward throughout the spring and appear to concentrate in the central Gulf of Alaska in June. They later disperse landward and migrate along the coastline until reaching their stream of origin (http://www.state.ak.us/adfg/notebook/fish/coho.htm).

III.B.2.a(5)(d) Sockeye Salmon (O. nerka)

Sockeye salmon, often referred to as "red" salmon, occur in the North Pacific and Arctic oceans and associated freshwater systems. This species ranges south to the Klamath River in California and northern Hokkaido in Japan to as far north as Bathurst Inlet in the Canadian Arctic and the Anadyr River in Siberia. Aboriginal people considered sockeye salmon to be an important food source and either ate them fresh or dried them for winter use. Today, sockeye salmon support one of the most important commercial fisheries on the Pacific coast of North America and are increasingly sought after in recreational fisheries; they remain an important mainstay of many subsistence users.

Sockeye salmon can be distinguished from chinook, coho, and pink salmon by the lack of large, black spots and from chum salmon by the number and shape of gill rakers on the first gill arch. Sockeye salmon have 28-40 long, slender, rough or serrated, closely set rakers on the first gill arch. Chum salmon have 19-26 short, stout, smooth rakers. Immature and prespawning sockeye salmon are elongate, fusiform, and somewhat laterally compressed. They are metallic green blue on the back and top of the head, iridescent silver on the sides, and white or silvery on the belly. Some fine black speckling may occur on the back, but large spots are absent. Juveniles inhabiting freshwater have the same general coloration as immature sockeye salmon in the ocean, but they are less iridescent. Juveniles also have dark, oval parr marks on their sides. These parr marks are short, less than the diameter of the eye, and rarely extend below the lateral line. Breeding males develop a humped back and elongated, hooked jaws filled with sharp, canine-like teeth. Both sexes turn brilliant to dark red on the back and sides, pale to olive-green on the head and upper jaw, and white on the lower jaw.

Sockeye salmon are anadromous; they live in the sea and enter freshwater systems to spawn. After hatching, juvenile sockeye salmon may spend up to 4 years in freshwater before emigrating to sea as silvery smolt. They grow quickly in the sea, usually reaching 2-4 kilograms (4-8 pounds) after 1-4 years. Mature sockeye salmon travel thousands of miles from ocean-feeding areas to spawn in the same freshwater system where they were born. Little is known about the navigation mechanisms or cues they use on the high seas, although some evidence suggests that they may use cues from the earth's magnetic field. Once near their natal freshwater system, sockeye salmon use olfactory cues to guide them home. Maturing sockeye salmon return to freshwater systems from the ocean during the summer months, and most populations show little variation in their arrival time to the spawning grounds from year to year. Like all Pacific salmon, sockeye salmon die within a few weeks after spawning.

Adult sockeye return to Cook Inlet and the Shelikof Strait region annually in late June, and runs continue through early August. Watersheds with lakes produce the greatest number of sockeye salmon. Spawning usually occurs in rivers, streams, and upwelling areas along lake beaches. The female selects the spawning site, digs a redd with her tail, and deposits eggs in the downstream portion of the redd as one or more males swim beside her and fertilize the eggs as they are extruded. After each spawning act, the female covers her eggs by dislodging gravel at the upstream end of the redd with her tail. A female usually deposits about five batches of eggs in a redd. Depending upon her size, a female produces from 2,000-4,500 eggs. Eggs hatch during the winter, and the young sac-fry, or alevins, remain in the gravel, living off their yolk sacs until early spring. At this time, they emerge from the gravel as fry and move into rearing areas. In watersheds with lakes, juveniles usually spend 1-3 years in freshwater before migrating to the ocean in the spring as smolts. However, in watersheds without lakes, many juveniles migrate to the ocean soon after emerging from the gravel.

Once in the ocean, sockeye salmon grow quickly. Mature sockeye salmon that have spent only 1 year in the ocean are called jacks and, almost without exception, are males. Sockeye salmon return to their natal stream to spawn after spending 1-4 years in the ocean. While returning adults usually weigh between 2 and 4 kilograms (4 and 8 pounds), weights in excess of 7 kilograms (15 pounds) have been reported. In some areas, populations of sockeye salmon remain in freshwater all their lives. This landlocked form of sockeye salmon, called "kokanee," reaches a much smaller maximum size than the anadromous form and rarely grows to be more than 36 centimeters (14 inches) long. While inhabiting freshwater, juvenile sockeye salmon feed mainly on zooplankton (for example, ostracods, cladocerans, and copepods), benthic amphipods, and insects. In the ocean, sockeye salmon feed on zooplankton (for example, copepods, euphausids, ostracods, and crustacean larvae), but they also prey on larval and small adult fishes (for example, sand lance) and occasionally squid (http://www.state.ak.us/adfg/notebook/fish/sockeye.htm).

III.B.2.a(5)(e) Chinook Salmon (O. tshawytscha)

The chinook (king) salmon is the largest of all Pacific salmonids, with weights of individual fish commonly exceeding 14 kilograms (30 pounds). A 57-kilogram (126-pound) chinook salmon taken in a fish trap near Petersburg, Alaska, in 1949 is the largest on record. The largest sport-caught chinook salmon was a 44 kilograms (97 pound) fish taken in the Kenai River in 1986.

The chinook salmon has numerous local names. In Washington and Oregon, chinook salmon are called chinook, while in British Columbia they are called spring salmon. Other names are quinnat, tyee, tule, blackmouth, and king salmon.

In North America, chinook salmon range from the Monterey Bay area of California to the Chukchi Sea, Alaska. On the Asian coast, chinook salmon occur from the Anadyr River area of Siberia southward to Hokkaido, Japan. In Alaska, this species is abundant from the Southeast Panhandle to the Yukon River. Major numbers make runs into the Yukon, Kuskokwim, Nushagak, Susitna, Kenai, Copper, Alsek, Taku, and Stikine rivers. Important runs also occur in many smaller streams.

Adults are distinguished by black irregular spotting on the back and dorsal fins and on both lobes of the caudal fin. Chinook salmon also have a black pigment along the gum line, which gives them the name "blackmouth" in some areas. In the ocean, the chinook salmon is a robust, deep-bodied fish with a bluish-green coloration on the back, which fades to a silvery color on the sides and white on the belly. Colors of spawning chinook salmon in freshwater range from red to copper to almost black, depending on location and degree of maturation. Males are more deeply colored than the females and also are distinguished by their "ridgeback" condition and hooked nose or upper jaw. Juveniles are recognizable by well-developed parr marks bisected by the lateral line.

Chinook salmon are anadromous; they hatch in freshwater, spend part of their life in the ocean, and then spawn in freshwater. All chinooks die after spawning. Chinook salmon become sexually mature sometime during their second through seventh year and, as a result, fish in any spawning run may vary greatly in size. For example, a mature 3-year-old probably will weigh less than 2 kilograms (4 pounds), while a mature 7-year-old may exceed 22 kilograms (50 pounds). Females tend to be older than males at maturity. In many spawning runs, males outnumber females in all but the 6- and 7-year age groups. Small Chinooks that mature after spending only one winter in the ocean are commonly referred to as jacks and usually are males. Alaska streams normally receive a single run of chinook salmon, from May through July.

Chinook salmon often make extensive freshwater spawning migrations to reach their home streams on some of the larger river systems. Yukon River spawners bound for headwaters in the Yukon Territory, Canada, will travel more than 3,219 river kilometers (2,000 river miles) during a 60-day period. Chinook salmon do not feed during the freshwater spawning migration, and their condition deteriorates gradually during the spawning run as their bodies consume stored energy reserves.

Each female deposits from 3,000-14,000 eggs in several gravel redds, which she excavates in relatively deep, moving freshwater. In Alaska, eggs usually hatch in late winter or early spring, depending on the timing of spawning and water temperature. Newly hatched fish, called alevins, live in the gravel for several weeks until they absorb their attached yolk sac. Later, these juveniles, now called fry, wiggle up through the gravel in early spring. In Alaska, most juvenile chinook salmon remain in freshwater until the following spring when they emigrate to the sea in their second year of life. These seaward emigrants are called smolts. Juvenile chinooks in freshwater feed on plankton and insects. In the ocean, they eat a variety of organisms including herring, pilchard, sand lance, squid, and crustaceans. Salmon grow rapidly in the ocean and often double their weight during a single summer season (http://www.state.ak.us/adfg/notebook/fish/chinook.htm). Spawning chinook salmon enter the proposed sale area during early May and are present in some spawning streams by the end of that month. During this same period, chinook salmon smolt are emigrating downstream to the North Pacific Ocean.

III.B.2.a(5)(f) Steelhead Trout (O. mykiss irideus)

The steelhead trout is a rainbow trout that has spent a part of its life in the sea. There are no major physical differences between rainbow and steelhead trout; however, their differing lifestyles have resulted in subtle differences in color, shape, and general appearance.

Generally speaking, steelhead are more slender and streamlined than rainbow trout. The coloration on the back of the steelhead is basically blue-green shading to olive with black, regularly spaced spots. Steelhead from the ocean are much more silver than the resident rainbow. The silvery sheen gradually fades in freshwater, and steelhead become difficult to differentiate from resident rainbow trout as the spawning period approaches. Spawning steelhead and rainbow develop a distinct pink-to-red stripelike coloration that blends along the side, both above and below the lateral line. On steelhead, the rainbow trout coloration gradually fades following spawning to the more characteristic silvery color that the fish display during their ocean journey. The silvery sheen and streamlined shape of ocean-bright steelhead is essential to survival in the ocean environment. Juvenile steelhead trout are identical to rainbow trout until the period prior to their ocean migrations. Young trout and stunted adults have 8-13 parr marks on their sides. Before immigrating to the sea, juvenile steelhead become very silvery and resemble miniature adults. They are called “smolt” during this life phase.

Steelhead are found in coastal streams of Alaska from the Dixon Entrance northward and west around the Gulf of Alaska down to the Cold Bay area on the Alaska Peninsula. There are no documented populations of steelhead on the Alaska mainland west of the Susitna River and north of the Chignik River system. This area is generally known as Bristol Bay and contains excellent resident rainbow trout populations but no steelhead. Steelhead are unevenly distributed throughout the Cook Inlet, Kodiak, and South Aleutian Peninsula region. Large numbers are intercepted in high-seas fisheries and, undoubtedly, many of these fish are of Alaska origin. Steelhead migrate to areas west of the Aleutian Islands and are routinely caught in net fisheries off the coast of Japan.

When compared to the habits of resident trout, steelhead lead a complicated and dangerous life. Each spring, thousands of 15-centimeter (6-inch) steelhead smolt leave streams to begin their ocean journeys. For every 100 smolt that reach the sea, only 5-10 will return as a first-spawning adult. Within a 1-, 2-, or sometimes 3-year period, Alaskan steelheads will move hundreds of miles from the parent stream. Some subpopulations return to home streams as early in the year as July and are known as “summer steelhead.” Summer steelhead are relatively rare in Alaska and found in only a few select streams in Southeast Alaska. Fall-run steelhead are much more common, particularly in the systems north of Frederick Sound. These fish enter the watersheds as adults in August, September, October, and on into the winter. The Anchor, Naha, Karluk, and Situk rivers have good fall runs of steelhead. Many of the Southeast Alaska systems have spring-run steelhead. These fish end their ocean journeys in mid-April, May, and June.

Spawning commences about mid-April and usually continues throughout May and early June. A male may spawn with several females, and more males than females die during the spawning period. Unlike salmon, steelhead commonly spawn more than once, and fish more than 71 centimeters (28 inches) almost always are repeat spawners. Spent spawners move slowly downstream to the sea, and their color returns to a bright silvery hue. Lost fats are restored, and adults again visit the feeding regions of their first ocean migration. On rare occasions, a fish will return to the spawning stream within a few months, but most repeat spawners spend at least one winter in the sea between spawning migrations. While adult spawning wounds heal and growth resumes, the eggs that were deposited deep in the gravel during spring quickly develop into alevins or sac fry. These tiny fish gradually absorb their yolk sac and work their way to the surface. By midsummer, fry emerge from gravel habitat, minus the yolk sac, and seek refuge along stream margins and in protected areas. Generally, juvenile steelhead remain in the parent stream for about 3 years before emigrating to saltwater (http://www.state.ak.us/adfg/notebook/fish/steelhd.htm).

III.B.2.a(5)(g) Cutthroat Trout (O. clarkii)

Cutthroat trout occur as sea-run or resident (nonsea run) forms in streams and lakes along the coastal range from lower Southeast Alaska to Prince William Sound and are the most common trout species in the region (http://www.state.ak.us/adfg/notebook/fish). The resident form lives in a wide variety of biotopes from small headwater tributaries and bog ponds to large lakes and rivers. Sea-run cutthroat usually are found in river or stream systems with accessible lakes, mostly south of Fredrick Sound. In some watersheds, such as the Taku River, the two forms are found together. The extent of breeding between the two forms is unknown, and the reason that some fish migrate to sea while others stay in freshwater remains unanswered.

Juveniles are 2-15 centimeters (1-6 inches) long and silver or yellowish, with about 10 oval parr marks overlaid with small black spots. Some juveniles have faint red or pink along the lateral line and on the gill covers. Adult coloration varies widely with habitat and life history: resident fish living in bog ponds are 15-40 centimeters (6-16 inches) long; are golden yellow with dark spots on the body and dorsal and caudal fins; and have a vivid red slash mark under the jaw (hence the name cutthroat). Free-swimming residents in large landlocked lakes can exceed 61 centimeters (24 inches) in length and are uniformly silver with black spots, rosy gill covers, and a faint slash mark. Sea-run cutthroat are smaller, seldom more than 46 centimeters (18 inches) long. They are bluish-silver with dark or olive backs and less conspicuous black spots. The characteristic slash is a faint yellow. Lack of a distinct slash mark in sea-run and resident forms has led anglers to confuse the fish with rainbow trout. Cutthroat can be positively identified with difficulty by the presence of minute teeth between the gills behind the base of the tongue.

Resident and sea-run coastal cutthroat trout have similar early life histories. Adults spawn in small, isolated headwater streams from late April to early June, and young cutthroat emerge from the gravel in July. The selection of isolated spawning areas is thought to reduce interaction of young cutthroat with more aggressive juvenile steelhead and coho salmon. Later, young occupy beaver ponds, sloughs, or lakes. Sea-run juveniles can be displaced to downstream mainstem and estuarine areas where they reside for the summer, then migrate back upstream with the onset of winter floods. Sea-run cutthroat rear for 3-4 years in freshwater and migrate to sea during May, when they are about 20 centimeters (8 inches) long. Time at sea varies from a few days to more than a hundred days before they return to their natal stream. During their migration, they follow the shoreline and do not cross open bodies of water and seldom venture farther than 48-72 kilometers (30-45 miles) from their home stream. In autumn, they return to their home stream where they mature during the winter months. Homing is very precise; cutthroat can return to the same tributary stream where they emerged and developed. Cutthroat mature at 5-7 years and live to be 9-10 years old. Survival through the winter and return to saltwater is about 40%. About 60% of the migrants are sexually mature, a characteristic that tends to limit egg deposition and reproductive potential. Resident coastal cutthroat remain in freshwater after emergence and live in streams, beaver ponds, sloughs, and lakes. In lakes, smaller cutthroat hide among lily pads, sunken logs, or rubble from which they dart out and seize insects and small fish. Some fish abandon this “sit and wait” feeding strategy when they reach about 36 centimeters (14 inches) in length and become cruisers, pursuing and eating other fish. Cutthroat adapting this feeding strategy can grow from 61-71 centimeters (24-28 inches), weigh 3 kilograms (8 pounds), and live to be more than 12 years old. These trophy-class cutthroat are found in large, landlocked lakes with populations of kokanee (landlocked sockeye salmon (*Oncorhynchus nerka*).

Mecklenburg, Mecklenburg, and Thorsteinson (2002) list the distribution of cutthroat trout to include coastal and insular waters east of the Kenai Peninsula at Gore Point and southward to California.

III.B.2.a(5)(h) Dolly Varden (Salvelinus malma)

Dolly Varden are locally abundant in all coastal waters of Alaska. Two basic forms of Dolly Varden occur in Alaska waters (http://www.state.ak.us/adfg/notebook/fish/dolly_v.htm). The southern form ranges from lower Southeast Alaska to the tip of the Aleutian Chain, and the northern form is distributed in north slope drainages of the Aleutian Range northward along Alaska's coast to the Canada border. Anadromous and freshwater varieties of both forms exist with lake, river, and dwarf populations being found among freshwater residents. Little is known of the habits of Alaskan nonmigratory Dolly Varden.

Young Dolly Varden have about 8-10 dark, wide parr marks or oval blotches that contrast with the mottled olive-brown color of their body. Sea-run fish are silvery with an olive-green to brown color on the dorsal surface and numerous red to orange spots on their sides. Mature males become brilliant red on the lower body surface, and ventral fins become reddish-black with white along the leading edges. Mature females are similar but less brightly colored. Males develop an extended lower jaw that hooks upward, fitting into a groove that forms in the upper jaw. A hook also forms in females but is considerably less pronounced.

Dolly Varden belong to a group of fish called char. The light spots on their sides distinguish them from most trout and salmon, which usually are black spotted or speckled.

Dolly Varden spawn in streams, usually during autumn from mid-August to November. Depending on her size, the female may deposit from 600-6,000 eggs (2,500-10,000 in the northern form) in depressions, or redds, which she constructs by digging with her tail fin in the streambed gravel. The male usually takes no part in nest-building activities and spends time fighting and chasing other males. When the female is ready to deposit her eggs, the male moves to her side and spawning begins. Sperm and eggs are released simultaneously into the redd.

Eggs develop slowly in cold water during the incubation period. Hatching of the eggs may occur in March, 4-5 months after fertilization. After hatching, the young derive sustenance from their yolk sac and usually do not emerge from the gravel until this food source is consumed. Emergence usually occurs in April or May for the southern form and in June for the northern form.

Young Dolly Varden rear in streams before moving to sea. During this rearing period, their growth is slow, a fact that may be attributed to their somewhat inactive habits. Young Dolly Varden often remain on the bottom, hidden under stones and logs, or in undercut areas along the stream bank, and appear to select most of their food from the stream bottom.

Most Dolly Varden emigrate to sea in their third or fourth year, but some linger as long as their sixth year. At this time, they are about 13 centimeters (5 inches) long and are called smolt. This emigration usually occurs in May or June, although significant but smaller numbers have been recorded emigrating to sea in September and October. This emigration is the initiation of a fascinating pattern of migration.

After their first emigration from natal habitat to sea, Dolly Varden usually spend the rest of their lives wintering in and migrating to and from freshwater. Southern form Dolly Varden overwinter in lakes, whereas most northern Dolly Varden overwinter in rivers. Those hatched and reared in a lake system conduct annual feeding migrations to sea and return to a lake or river each year for the winter. However, southern Dolly Varden originating from nonlake systems must seek a lake in which to winter. Recent research indicates that they locate lakes by random searching, moving from one stream to another until they find one with a lake. Once a lake is found, these fish may conduct annual seaward migration in the spring, sometimes entering other stream systems in their search for food.

At maturity, Dolly Varden return to spawn in their stream of natal origin. The fish possesses the ability to find their "home" stream without randomly searching, as is used for locating suitable wintering habitat. Those of the southern form that survive the rigors of spawning return to a lake shortly thereafter, while northern form Dolly Varden usually overwinter in the river system in which they spawned.

Most southern form Dolly Varden reach maturity at age 5 or 6 years. At this age, they may be 30-41 centimeters (12-16 inches) long and may weigh from 0.2-0.5 kilograms (0.5-1 pound). Northern form Dolly Varden reach maturity at age 5-9 years after having spent three or four summers at sea, and may be 41-61 centimeters (16-24 inches) long. Mortality after spawning varies, depending on the sex and age of the fish. Males experience a much higher mortality rate after spawning, partly due to fighting and the subsequent damage inflicted on each other. It is doubtful that much more than 50% of the Dolly Varden live to spawn a second time. A small number may live to spawn more than twice. Few southern Dolly Varden appear to live longer than 8 years. Northern Dolly Varden may live as long as 16 years, but individuals over age 10 years are uncommon. Maximum size for southern Dolly Varden is between 38-56 centimeters (15-22 inches) and up to nearly 2 kilograms (4 pounds); however, occasional 4- 5-kilogram (9- to 12-pound) giants are reported, especially in northern populations.

Additional information regarding Dolly Varden in Alaskan waters may be found in Mecklenburg, Mecklenburg, and Thorsteinson (2002).

III.B.2.b. Groundfish

The term “groundfish” loosely groups the finfishes that, for much of their time, remain near the seafloor. Spawning and early life, however, may be in pelagic waters. The following groundfish species are considered commercially valuable in the Cook Inlet, Kodiak, and South Aleutian Peninsula regions.

III.B.2.b(1) Pacific Cod (*Gadus macrocephalus*)

The Pacific cod is a largely demersal (bottom-dwelling) fish that may reach a length of 1 meter (3.25 feet). Pacific cod are fast growing, maturing in 3 years. There is concurrently rapid turnover in subpopulations, as predation and commercial fishing take their toll. Pacific cod form aggregations during the peak spawning season, which extends approximately from January through May (North Pacific Fishery Management Council, 1998). The adhesive, demersal eggs hatch in about 13-14 days, depending on water temperature. The resultant larvae are pelagic for a time before entering the benthos. Pacific cod feed on pollock, herring, smelt, mollusks, crabs, shrimp, and other similar-sized marine organisms (Hart, 1973).

III.B.2.b(2) Pacific Hake (*Merluccius productus*)

The Pacific hake (Pacific whiting), a codlike fish may be found throughout the Cook Inlet region although not in large numbers. Ranging to about 91 centimeters (36 inches) in length, its principal identifying characteristic is the presence of two dorsal fins. Hake spawn for an extended annual period, possibly for up to several months in this region. Depending on the size of the fish, hake may release nearly a half-million eggs per individual, and the pelagic eggs may hatch in as little as 3 days. Hake are demersal in nature, although they sometimes make vertical ventures into the water column at night, probably for feeding. Larval hake consume copepods and similarly sized organisms. Adult hake prey on euphausiids, sand lance, anchovies, and other forage fishes. In turn, hake are prey for other marine fishes, marine birds, and marine mammals.

III.B.2.b(3) Walleye Pollock (*Theragra chalcogramma*)

This codlike species occurs throughout the proposed sale area, with a large spring spawning aggregation in parts of Shelikof Strait. Pollock are found at depths of 20-2,000 meters (11-1,094 fathoms). The species also inhabits pelagic waters in some areas at various times. In size, walleye pollock range to 91 centimeters (36 inches) long; however, they enter the commercial-trawl fisheries at about 25 centimeters (12 inches) long (Hood and Zimmerman, 1986). Adult pollock consume shrimp, sand lance, herring, small salmon, and similar organisms they encounter. Walleye pollock also are cannibalistic.

Walleye pollock spawn in the spring in large aggregations, although there is extended spawning by smaller numbers throughout the year. Eggs may be close to the surface initially and hatch in about 10-20 days (depending on water temperatures). Pelagic larvae remain at the sea surface for up to 30 days, again depending on water temperature (and available food supply). Fisheries survey data indicate larval pollock may use the stratified warmer upper waters of the midshelf to avoid predation by adult Pollock, which reside in the colder bottom water (North Pacific Fishery Management Council, 1998).

III.B.2.b(4) Pacific Ocean Perch (*Sebastes alutus*)

This representative species of the 30 rockfish species so far recovered from the Gulf of Alaska ranges over much of the continental shelf of the Gulf of Alaska westward to the nations of the Russian Commonwealth.

This group is unique in that many are very long lived and bear their young alive (as opposed to spawning eggs into the water). The Pacific Ocean perch was formerly a much-sought-after commercial species that was then overexploited.

Adult Pacific Ocean perch usually are found in gravel, rocky, or boulder-strewn substrates in and along the gullies, submarine canyons, and depressions of the upper continental slope. Larvae and juveniles are pelagic until joining adults in these demersal habitats after 2 or 3 years.

III.B.2.b(5) Sablefish (*Anoplopama fimbria*)

Sablefish (black cod) are found within the Cook Inlet proposed sale area and is a valued commercial species. However, most are harvested outside the sale area, because this species usually occurs at depths of 366-915 meters (200-500 fathoms). Sablefish are largely demersal in habit with some nocturnal forays into pelagic waters. Sablefish range to 1 meter (40 inches) in length and are a relatively long-lived species (some to 35 years). Sablefish probably spawn during the spring, but little is known about their spawning movements or egg-larval development. The eggs are pelagic as are the early prolarvae. Later larval stages occupy waters 150 meters in depth. Sablefish are indiscriminate feeders on a large variety of benthic and pelagic fauna.

III.B.2.b(6) Pacific Halibut (*Hippoglossus stenolepis*)

The largest of the flounder family, Pacific halibut, inhabit much of the Cook Inlet proposed sale Area. Halibut are demersal and inhabit depths ranging from 50-500 meters (North Pacific Fishery Management Council, 1998). Halibut are more elongated than most flatfishes, the width being about one-third the length. Small scales are imbedded in the skin. Halibut have both eyes on their dark, or upper, side. The color on the dark side varies but tends to assume the coloration of the seafloor; the underside is lighter. This color adaptation probably allows halibut to avoid detection by both prey and predator.

Spawning takes place during winter months and peaks from December through February. Most spawning takes place on the continental slope in waters 366-549 meters (200-300 fathoms) in depth. Male halibut sexually mature at 7 or 8 years of age, and females sexually mature at 8-12 years. Females lay 2-3 million eggs annually, depending on their size. Fertilized eggs hatch after about 15 days. Free-floating eggs and larvae float for up to 6 months and are transported up to several hundred miles by currents of the North Pacific. During the planktonic stage, many developmental changes occur in the young halibut, including migration of the left eye to the right side of the fish. During this time, young halibut rise to the surface and are carried to shallower waters by prevailing currents. In shallower waters, young halibut then assume demersal lifestyles. Most young halibut ultimately spend from 5-7 years in rich, shallow nursery grounds as in the Bering Sea.

Young halibut, up to 10 years of age, are highly migratory and generally migrate in a clockwise direction east and south throughout the Gulf of Alaska. Halibut in the older age classes tend to be much less migratory. Older fish often use both shallow and deep waters over the annual cycle; however, they have much smaller “home ranges” than younger, more migratory fish.

Research indicates that there may be small, localized spawning subpopulations in deep waters such as in Chatham Straight in northern Southeast Alaska. However, because of the free-floating nature of eggs and larvae and subsequent mixing of juvenile halibut from throughout the Gulf of Alaska, there is only one known genetic stock of halibut in the northern Pacific. Halibut growth rate varies depending on locations and habitat conditions. Females grow faster and live longer than males. The oldest recorded female was 42 years old, and the oldest male was 27 years old. The largest ever recorded for the northern Pacific was a 225-kilogram (495-pound) fish caught near Petersburg, Alaska. Being strong swimmers, halibut can eat a large variety of fishes (for example, cod, turbot, pollock) and some invertebrates (for example, crab and shrimp). Sometimes halibut leave the seafloor to forage on pelagic fish (for example, sand lance and herring) (http://www.state.ak.us/adfg/notebook/fish/halibut.htm).

III.B.2.b(7) Other Groundfish

Lesser numbers of arrowtooth flounder, yellowfin sole, Atka mackerel, and other groundfish inhabit the Cook Inlet, Kodiak, and South Aleutian Peninsula region. These species generally are in the same habitats as the previously discussed groundfish species.

III.B.2.c. Shellfish

"Shellfish" is a collective term that generally refers to harvestable mollusks and crustaceans. The coastal ecosystem of the Gulf of Alaska underwent a shift from an epibenthic community dominated largely by crustaceans to one now dominated by several species of finfishes (Anderson, Blackburn, and Johnson, 1997). The reorganization of domineering species in coastal waters resulted from a shift in ocean climate during the late 1970's (Anderson and Piatt, 1999). Analysis of climatological data from the northeast Pacific led Ware (1995) to predict another regime shift to occur in early 2000. If so, cold regime conditions are predicted to enhance crustacean abundance again, while dampening groundfish and salmon numbers (Anderson and Piatt, 1999).

III.B.2.c(1) Razor Clam *(Siliqua patula)*

The razor clam is an important bivalve mollusk harvested extensively throughout its range by commercial and sport fisheries (http://www.state.ak.us/adfg/notebook/shellfsh). Its scientific name is derived from the Latin: *siliqua* means pod, and *patula* means open; thus, "resembling an open pod." The razor clam was first described in 1788 from specimens found near Coal Harbor, Alaska, which was adjacent to the present Kenai Peninsula community of Homer. Four species are currently considered to be present on the west coast of North America. The two most frequently encountered species of razor clam are the Pacific (*S. patula*) and the northern or Arctic razor clam (*S. alta*). The Arctic razor clam is found in southern Cook Inlet westward to the Bering Sea and Siberia. The Pacific razor clam is more widely distributed and is found from Pismo, California north to the Aleutian Islands. *S. patula* is the more-frequently encountered of the two species.

The long, narrow shell of *S. patula* may attain a length greater than 18 centimeters (7 inches). In very young specimens, the periostracum, or outermost tissue-like layer of the shell, is brown. It gradually becomes yellowish-brown in medium-sized animals and changes again to brown with age. The periostracum of large or old specimens usually is eroded. The inside of the shell is glossy white, sometimes with purple areas showing through and a prominent rib extends from the upper or early part of the shell to the shell edge. *S. patula* can be distinguished from *S. alta*, because the latter generally has a heavier, broader, darker shell. Also, all exposed parts of the mantle (the fold or lobe that contains the shell-secreting glands, siphon (neck), and foot of *S. alta* are colored by dark brown pigment, distinguishing it from *S. patula*, which lacks this coloration. The siphon of *S. patula* is less closely fused, has a distinct tendency to separate near the opening, and lacks tubercles. *S. alta* is found higher on beaches and, owing to its short siphon, stays closer to the surface. These characteristics make it easy for commercial and recreational clamdiggers to tell the two species apart.

S. patula may become sexually mature as early as the end of its third growing season or following the formation of the third annulus ring; all are probably sexually mature by the time they enter their seventh growing season. Breeding occurs between May and September and is closely associated with rising water temperatures. A temperature of nearly 13 ºCelsius (55 °Fahrenheit) is believed to be required to trigger spawning. Sexes are separate in razor clams. In breeding, eggs and sperm are discharged onto wet sand and into seawater. Fertilization occurs by chance. Where the razor clam's reproductive cycle lacks efficiency, it compensates with numbers. Although an exact count of the number of eggs contained in a female razor clam is not probable, some researchers estimated that number at between 300,000 and 118.5 million. The larger the female razor clam, the greater the number of eggs produced. The chance of survival for an individual egg is very low. Microscopic larvae bear little resemblance to parent clams. They have short, hair-like projections called cilia with which to propel them. Toward the end of the larval free-swimming period (veliger stage), which may last from 5-16 weeks, shells begin to form and the young start resembling clams. Young clams then take up residence in sand where their growth rate varies from area to area. Some razor clams in Alaska have attained the age of 18 years, and it is possible that older individuals exist.

Razor clams live in surf-swept and somewhat protected sand beaches of the open ocean. They are found from approximately 1.2 meters (4 feet) above the mean low-water level down to depths of 55 meters (180 feet). Large assemblages of razor clams occur in waters near Augustine Island of western Cook Inlet. Additional large assemblages of razor clams inhabit Kachemak Bay.

Razor clams subsist on phyto- and zooplankton filtered from surrounding seawater.

Rarely, small cysts are imbedded in the siphon of the razor clam. These cysts are one of the intermediate stages in the life cycle of a parasitic nematode (round worm) of the common skate. They evidently do not affect the razor clam. Occasionally, a small pink or white leach-like animal may be found attached to the inside of the siphon. This is a nemertean worm that lives commensally without harming the razor clam.

III.B.2.c(2) Pacific Weathervane Scallop (*Patinopecten caurinus*)

The Pacific weathervane scallop is one of several species of true scallops, family Pectinidae, found in the eastern North Pacific Ocean. This scallop supports a sporadic but important commercial fishery in Alaska waters from Yakutat to the eastern Aleutians.

Weathervane scallops are bivalves, referring to the two flattened, shelly valves that are hinged together. Shell lengths may reach 20 centimeters (8 inches) or larger at maturity. The shells are a brownish color on the outside and have many prominent heavy ribs.

Generally weathervane scallops are sexually mature at age 3 or 4 years and are of commercially harvestable size at 6-8 years. Age is determined by counting the annuli, concentric rings on the shell, which are formed with the colder or warmer water temperatures of winter or summer. Scallops are found in beds (areas of abundant numbers), and are dioecious, having separate sexes. Spawning occurs in June and July where the spermatozoa and ova are released into the water. Ova that are fertilized will settle to the bottom. After approximately 1 month, hatching occurs and larvae drift with the tidal currents. Over the following 2-3 weeks, larvae gain shell weight, settle to the bottom, and attach themselves to seaweed. Within 4-8 weeks after settling, juveniles develop the ability to swim. At this time, the juvenile scallop is approximately 0.9 centimeters (0.4 inches) in diameter and assumes the adult form. Growth is very rapid the first few years and is minimal after age 10. Scallops may live for 18 years.

Weathervane scallops have specialized adaptations that facilitate escaping predation or other disturbing conditions. Scallops are the only bivalves whose adult stage is capable of swimming. This ability is accomplished by the rapid ejection of water from the interior of the shell in a jet-like action. Swimming can be maintained for 15-20 seconds and rarely exceeds 6 meters (20 feet). Another unique adaptation of scallops includes the presence of many jewel-like eyes that are sensitive to changing light or moving objects. Also, scallops have small tentacles that are highly sensitive to waterborne chemicals and water temperature. Prominent heavy ribbing on the shell halves serve as strengthening structures to complete the scallop’s defenses.

Weathervane scallops are found on sand, gravel, and rock bottoms from 45-183 meters (150-600 feet). In Cook Inlet, there are two scallop beds easterly of Augustine Island in 38-115 meters (120-360 feet) that are commercially harvested (Lambdin, 2003, pers. commun.). Weathervane scallops feed by filtering microscopic plankton from the water.

III.B.2.c(3) Pandalid Shrimp

Five species of pandalid shrimp of various commercial and subsistence values are found in the cool waters off the coast of Alaska (http://www.state.ak.us/adfg/notebook/shellfish/shrimp.htm). **Pink shrimp** (*Pandalus borealis*) are the foundation of the commercial trawl shrimp fishery in Alaska. Pinks are circumpolar in distribution, though the greatest concentrations occur in the Gulf of Alaska. Ranging from Puget Sound to the arctic coast of Alaska, the **humpy shrimp** (*P. goniurus*) usually is harvested incidentally to pink shrimp. In some cases, however, the humpy constitutes the primary species caught. Both pink and humpy shrimp usually are marketed as cocktail or salad shrimp. Known for its sweet flavor, the **sidestripe shrimp** (*Pandalopsis dispar*) also is caught incidentally to pinks; however, there are small trawl fisheries in Prince William Sound and Southeast Alaska that target on this deeper water species. The **coonstripe shrimp** (*Pandalus hypsinotis*) is the prized target of various pot shrimp fisheries around the State. Coonstripe shrimp can be found from the Bering Sea to the Strait of Juan de Fuca, while sidestripes range from the Bering Sea to Oregon. **Spot shrimp** (*P. platyceros*) is the largest shrimp in the North Pacific. Ranging from Unalaska Island to San Diego, this species is highly valued by commercial pot fishers and subsistence users alike. Most of the catch from the sidestripe, coonstripe, and spot fisheries is sold fresh in both local and foreign markets.

Pandalid shrimp can be characterized by a long, well-developed spiny rostrum and are medium to large in size for shrimp. The body generally is slender, and there are five pairs of "swimmerets" located on the underside of the abdomen. Pinks exhibit uniform coloration from light to reddish pink. The humpy shrimp is also light to reddish pink but has a series of reddish dots that form faint stripes backwards across the abdomen (or body). Midway down the back is a pinched area or "hump," which further distinguishes the humpies from pinks. Pinks and humpies are the smallest of the commercial pandalids. Coonstripes are very robust, have large heads, and have a series of dark bands on both legs and body. The sidestripe is relatively slender with characteristic long antennules. A light pink in color, sidestripes earn their title by the presence of white bands that run the length of the abdomen. Both coonstripes and sidestripes are medium in size. Spot shrimp are large and stout and are light brown to orange in color. Conspicuous, white, paired spots located just behind the carapace (head) and just in front of the tail give the spot shrimp its common name.

Pandalid shrimp exhibit protandrous hermaphroditism (each individual spends the early mature part of its life as a male and later transforms into a female for the balance of its lifetime). For example, a pink shrimp typically will mature sexually as a male, spawn one or more times, pass through a short transitional phase, and subsequently mature and spawn as a female. In the spring after about a 6-month incubation, the eggs hatch into planktonic, free-swimming larvae. By midsummer, the larvae have undergone several molts, rapidly increasing in size after each molt. After the last larval molt, the shrimp transforms into a juvenile and settles to the bottom. After a year or so, the juvenile molts and develops into a mature male and may spawn as a male for one or two seasons. Some juveniles, however, never mature into males; instead, they develop directly into females. Prior to fertilization, the mature female molts into a shell specialized for carrying eggs. Male and female grasp and the male deposits a packet of sperm on the underside of the female. Egg release follows soon after mating, and the eggs are fertilized as they pass externally underneath the abdomen of the female, where they attach to hairlike structures (setae). The female carries the developing eggs until they hatch. Clutch size in pandalid shrimp ranges from a few hundred eggs to about 4,000 eggs and usually is proportional to the size of the female. Fall-spawning and spring-hatching seasons are the usual case, but timing varies with species and range.

Shrimp inhabit varying depths and habitat types. Spots and coonstripes generally are associated with rock piles, coral, and debris-covered bottoms; whereas pinks, sidestripes, and humpies typically occur over muddy bottom. Pink shrimp occur over the widest depth range (18-1,463 meters, or 10-800 fathoms); while humpies and coonstripes usually inhabit shallower waters (5-366 meters, or 3-200 fathoms). Spot shrimp seem to be caught in greatest concentrations around 110 meters (60 fathoms) but range from 4-457 meters (2-250 fathoms). Sidestripes typically are found from 46-641 meters (25-350 fathoms), but most concentrations occur in waters deeper than 73 meters (40 fathoms).

Most shrimp migrate seasonally from deep to shallow waters in addition to exhibiting diel migrations vertically within the water column. Pink shrimp, for example, have been observed moving off the bottom in the evening, occupying the whole water column for much of the night and returning to the bottom in early morning Pandalid shrimp are opportunistic bottom feeders that will eat a wide variety of items such as worms, diatoms, detritus (dead organic matter), algae, and various invertebrates. Shrimp themselves often are the diet of large predator fish such as Pacific cod, walleye Pollock, flounders, and salmon.

III.B.2.c(4) Alaskan King Crabs

King or **stone crabs** occur around the world. Commercial fisheries have existed for them in Alaska, Canada, Russia, Japan, Korea, New Zealand, Australia, South Georgia, and the Falkland Islands, Argentina, and Chile (http://www.state.ak.us/adfg/notebook/shellfish/kingcrab.htm). King crabs have "tails," or abdomens, that are distinctive, being fan shaped and tucked underneath the rear of the shell.

They also have five pairs of legs. The first pair bears their claws or pincers (the right claw usually is the largest on the adults). The next three pairs are their walking legs. The fifth pair of legs are small and normally are tucked underneath the rear portion of the carapace (the shell covering their back). Adult females uses these specialized legs to clean embryos (fertilized eggs), and the male uses them to transfer sperm to the remale during mating.

In Alaska, there are three commercial king crab species. **Red king crabs** (*paralithodes camtschaticus*, have been the commercial "king" of Alaska's crabs. It occurs from British Columbia to Japan, with Bristol Bay and the Kodiak Archipelago being the centers of its abundance in Alaska. **Blue king crabs**, *P. platypus*, live from southeastern Alaska to Japan, with the Pribilof Islands and St. Matthew Island being their areas of highest abundance in Alaska. **Golden king crabs**, *Lithodes aequispinus*, are distributed from British Columbia to Japan, with the Aleutian Islands their Alaskan stronghold of abundance. Red and blue king crabs can occur from the intertidal zone to 183 meters (100 fathoms) or more. Golden king crabs live mostly between 183-732 meters (100-400 fathoms) but can occur from 91-914 meters (50-500 fathoms).

Adult females brood thousands of embryos beneath their tail flap for about a year. When the embryos are fully developed, they hatch as swimming larvae, but their movements are effectively influenced by tidal currents. After feeding on plant and animal plankton for several months and undergoing several transformations with each molt, larvae settle to the ocean floor and molt into nonswimmers. At this stage, they look for the first time like king crabs as we normally think of them, but they are smaller than a dime. Red and blue king crabs settle in waters less than 27 and 61 meters (15 and 33 fathoms) deep, respectively; while golden king crabs appear to settle in waters 91 meters (50 fathoms) or deeper.

Because a crab's skeleton is its shell (made mostly of calcium), it must molt its shell to grow. Juveniles molt numerous times in their first few years and then less frequently, until they reach sexual maturity in 4 or 5 years. Adult females must molt in order to mate, but males do not. Adult males often skip a molt and keep the same shell for 1 or 2 years. Red king crabs are the largest of these three species, with the record female and male weighing nearly 4 and 9 kilograms (11 and 24 pounds), respectively. These large crabs were estimated to be 20-30 years old. The male's leg span was nearly 2meters (5 feet) across.

Adult red and blue king crabs exhibit nearshore to offshore (or shallow to deep) annual migrations. They move to shallow water in late winter and by spring, the female's embryos hatch. Adult females and some adult males molt and mate before they return to offshore feeding areas in deeper waters. Adult crabs tend to segregate by sex off the mating-molting grounds. Red, blue, and golden king crabs are seldom found coexisting with one another, even though the depth ranges they live in and habitat areas may overlap. Adult male red king crabs have been known to migrate up to 161 kilometers (100 miles) round-trip annually, moving at times as fast as 1.6 kilometers (1mile) per day. Less is known of the migration of golden king crabs, but it is believed they migrate rather vertically, because they generally inhabit steep-sided ocean bottoms.

King crabs are known to eat a wide assortment of marine life including worms, clams, mussels, snails, brittle stars, sea stars, sea urchins, sand dollars, barnacles, crabs, other crustaceans, fish parts, sponges, and algae.

King crabs are consumed by a wide variety of predators including, but not limited to, fishes (Pacific cod, sculpins, halibut, yellowfin sole); octopuses; king crabs (they can be cannibalistic); sea otters; and several species of nemertean worms, which have been found to eat king crab embryos.

III.B.2.c(5) Dungeness Crab (*Cancer magister*)

The Dungeness crab is a popular shellfish that inhabits bays, estuaries, and nearshore waters of Alaska (http://www.state.ak.us/adfg/notebook/shellfish/dungie.htm). The Dungeness crab is named after one of its representative habitats—a shallow, sandy bay inside of Dungeness Spit on the south shore of the Strait of Juan de Fuca. It is widely distributed and can be found as far north as Cook Inlet and Prince William Sound and south to Magdalena Bay, Mexico. This crab supports both a commercial fishery and a personal-use fishery in Alaska. Dungeness crabs are related to shrimps, lobsters, and other crabs. The Dungeness crab has a broad, oval body covered by a hard, chitinous shell. It has four pairs of walking legs and a pair of claws. This species can be distinguished from other commercially important crabs (king and tanner crabs), because its legs are much smaller and shorter in relation to its body size, and it has no spines on the top side of its carapace (shell).

Dungeness crabs mate from spring through autumn. Male crabs are polygamous—each male crab may mate with more than one female crab. This may be an important factor in maintaining the reproductive viability of stocks, because only male crabs can be harvested in commercial and personal-use fisheries. Male crabs mate only with female crabs that have just molted (shed their old exoskeleton). Fertilization of the egg does not occur at the time of mating. The female crab stores the sperm until her eggs are fully developed. Eggs are fertilized when the female extrudes them under her abdomen where they are carried until hatching. A large female crab can carry 2.5 million eggs.

After hatching, the young crabs are chiefly planktonic but capable of freely swimming away from the female parent. Larval development takes from 4 months to as long as a year in Alaska. Lavae undergo six successive stages (five zoea and one megalopa) before molting into the first juvenile stage. Crabs grow each time they molt. During the first 2 years, both sexes grow at similar rates but thereafter, female crabs grow more slowly than males. Sexual maturity may be reached at 3 years. At 4-5 years of age, a Dungeness crab can exceed 16 centimeters (6 inches) in shell width and weigh between 746 and 1,120 grams (2-3 pounds). A large male Dungeness crab can exceed 25 centimeters (10 inches) in shell width. The estimated maximum life span of this crab is between 8 and 13 years.

Dungeness crabs are widely distributed subtidally and prefer a sandy or muddy bottom in the sea. However, they are tolerant of salinity changes and can be found in estuarine environments. Crabs generally inhabit waters shallower than 27 meters (15 fathoms), but they have been found in depths down to 183 meters (100 fathoms).

Dungeness crabs scavenge along the seafloor for organisms that live partly or completely buried in the sand. They are predators, and will consume shrimp, mussels, small crabs, clams, and worms.

III.B.2.c(6) Tanner Crabs (*Chionoecetes bairdi* and *C. opilio*)

Tanner crabs are two of the four species of the genus *Chionoecetes* occurring in the eastern North Pacific Ocean and Bering Sea (http://www.state.ak.us/adfg/notebook/shellfish/tanner.htm). They form the basis of a thriving domestic fishery from southeastern Alaska north through the Bering Sea. These crabs also are marketed under their trade names: snow crab (*C. opilio*) and tanner crab (*C. bairdi*).

Tanner crabs are brachyuran (meaning short-tailed) or true crabs and constitute some of the most highly specialized of all crustaceans. The body is composed mainly of a chitinous shell or carapace with a small abdominal flap. They have five pairs of legs, with the first pair equipped with pincers. Tanners may live to an estimated maximum age of 14 years. Males of commercial size usually range from 7-11 years of age and vary in weight from 373-746 grams (1-2 pounds) for *C. opilio* and 746-1,492 grams (2-4 pounds) for *C. bairdi*.

Females molt to sexual maturity and mate in the softshell condition while grasped by the male. The male crab is attracted by a pheromone released by the female. Older, hardshelled females also are mated by adult males; however, in the absence of a male they are capable of producing an egg clutch with sperm stored from a previous mating. A female tanner crab may deposit 85,000-424,000 eggs in a clutch.

Fertilization is internal, and the eggs usually are ovulated (extruded) within 48 hours onto the female's abdominal flap where they incubate for a year. Hatching occurs late the following winter and spring, with the peak hatching period usually during April to June. This is normally the peak of the spring plankton bloom, and hatching eggs coincide with abundant food resources for the larvae crab.

The young, free-swimming larvae molt numerous times and grow through several distinct stages. Growth during this period usually depends on water temperature but lasts about 63-66 days, after which the larvae lose their swimming ability and settle to the ocean floor. After numerous molts and several years of growth, females mature at approximately 5 years of age. Males mature at about 6 years.

Tanner crabs feed on assorted worms, clams, mussels, snails, crabs, other crustaceans, and fish parts. They are consumed by groundfish, pelagic fish, and humans. Migration patterns are poorly understood; however, it is known that the sexes are isolated during much of the year and coinhabit areas during mating season.

III.B.3. Essential Fish Habitat

III.B.3.a. Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) (P.L. 94-265; 16 U.S.C. 1801-1882) established and delineated an area from the State's seaward boundary out 200 nautical miles as a fisheries conservation zone for the United States and its possessions. The MSA established national standards for fishery conservation and management, and created eight Regional Fishery Management Councils to apply those national standards in fishery management plans. Congress amended and reauthorized the MSA through passage of the Sustainable Fisheries Act of 1996. The reauthorization implements a number of reforms and changes. The MSA, as amended, requires each fishery management plan to be based on the best available scientific and economic data, as applicable to fisheries resources that are in need of conservation and management within each respective region.

Another provision requires that Fishery Management Councils identify and protect essential fish habitat for every species managed by a fishery management plan (50 CFR 600). Essential fish habitat (EFH) is defined as the water and substrate necessary for fish spawning, breeding, feeding, and growth to maturity. Section 600.10 defines "waters" as aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate. "Substrate" is the sediment, hard bottom, and structures underlying the waters and associated biological communities. The act requires Federal Agencies to consult on activities that may adversely affect essential fish habitats designated in the fishery management plans. An adverse effect is "…any impact which reduces the quality or quantity of essential fish habitat." The activities may have direct (for example, physical disruption) or indirect (for example, loss of prey species) effects on essential fish habitats and be site-specific or habitatwide. Prey is an important component of essential fish habitat; loss of prey renders some areas uninhabitable to fishes and, therefore, constitutes an adverse effect. Adverse effects must be evaluated individually and cumulatively.

III.B.3.b. Essential Fish Habitat

Five fishery management plans exist for fisheries in Alaska. They cover groundfish in the Gulf of Alaska, groundfish and crabs in the Bering Sea and Aleutian Islands, and salmon and scallops Statewide. Those relating to this lease sale include the Gulf of Alaska groundfish and Statewide salmon and scallop management plans. Essential fish habitat for the respective management plans are described and delimited in an Environmental Assessment of Essential Fish Habitat (North Pacific Fishery Management Council, 1999) and in Habitat Assessment Reports (North Pacific Fishery Management Council, 1998). These documents are being updated with new information, and may be available later in 2003.

Table III.B-1 lists federally managed fish species and important forage fishes inhabiting the Gulf of Alaska. Most of the listed species are EFH species, meaning that the North Pacific Management Council has described and delimited EFH areas for these species based on the available scientific information. With the exception of a few better-known fish species, EFH has been described for several specific fish "complexes," such as rockfish complex, which comprises a suite of species managed under the "complex" title. The consolidation of various species into complexes is due in large part to the lack of scientific information known those species included in the various "complexes." Most complexes are comprised of taxonomically similar species. The most comprehensive and problematic complex is that of the forage fishes, which includes a suite of taxonomically dissimilar fishes.

Forage fish are by definition prey for other animals. However, this simple definition would include, in all probability, all species at some stage of their life cycle. However, forage fishes do not include all the species but only a small subset. Therefore, forage fishes are abundant, schooling fishes that are preyed on by many species of seabirds, marine mammals, and other fish species. They provide critical ecosystem functions by transferring energy from primary or secondary producers to higher trophic levels (Springer and Speckman, 1997). The structure of the forage fish community is a critical component of the ecosystem. The community relationships are complex. A number of managed fish species such as salmon, cod, and halibut feed on forage fish. A number of forage fish, such as pollock and herring, are also commercially valued fish species. Adult forage fish, such as pollock, also prey on the young of their own species. Many forage fish and commercial fishes also prey on the euphausiids and other zooplankton during at least one of their life stages. Zooplankton sometimes feed on the larval stages of forage and commercial fish. This complexity is especially exemplified by walleye pollock, a key species in the proposed sale area (see Figure III.B-7). Herring and halibut technically are not EFH species, because the two species are managed by the State of Alaska rather than by the North Pacific Fishery Management Council under the Sustainable Fisheries Act (P.L. 104-297). Because adverse impacts to prey, such as herring or other forage fish species, may degrade the quality or quantity of EFH, our analysis includes the potential effects of the Proposed Action on herring and other forage fishes.

This EFH analysis relies on documents developed by the National Marine Fisheries Service (North Pacific Fishery Management Council, 1998, 1999) for characterizing habitats of various managed fish species and their prey, which the Sustainable Fisheries Act of 1996 requires us to analyze.

The North Pacific Fisheries Management Council mapped the general and concentrated habitats of many of the species. However, there are no systematic sampling data available for egg, larval, and early juvenile stages of any species, except pollock (North Pacific Fishery Management Council, 1998).

There are limited studies of nearshore and demersal fish habitat associations in Kachemak Bay, Alaska. Abookire and Norcross (1998, Norcross et al., 1997) found juvenile flathead sole (*Hippoglossoides elassodon*) and rock sole (*Pleuronectes bilineatus*) were the most abundant flatfishes during annual sampling from 1994-1996. Year-round habitat of age-0 flathead sole primarily was from 40-60 meters (22-33 fathoms), and habitat of age-1 flathead sole primarily was from 40-80 meters (22-44 fathoms). Summer habitat of ages-0 and 1 rock sole was from 10-30 meters (6-16 fathoms), and in winter age-0 rock sole moved offshore to sites as deep as 150 meters (82 fathoms). Both age classes of flathead sole were most abundant on mixed mud sediments, while age-1 also were in high abundance on muddy sand sediments. Ages-0 and 1 rock sole were most abundant on sand, although age-1 also were found on a variety of sediments finer and coarser grained than sand. Thus, juvenile flathead sole and rock sole had distinctive depth and sediment habitats. When habitat overlap occurred between the species, it primarily was when rock sole moved offshore in the winter. Additional summer groundfish surveys of Kachemak Bay revealed that most captured groundfishes were juveniles, and the most abundant fishes were the rock soles and Pacific cod (Abookire et al., 2001). Other common species were flathead sole, slimy sculpin (*Radulinus asprellus*), Pacific halibut, and arrowtooth flounder. Juvenile groundfishes were concentrated in either shallow (20 meters [11 fathoms] or less) or deep (50-70 meters [27-38 fathoms]) water, with some co-occurrence of some species between 30 and 40 meters (98 and 131 feet). Kachemak Bay is divided into Outer and Inner regions by the extension of Homer Spit; sampling of the Inner and Outer bays showed that the Inner Bay supports more species and higher densities of schooling and demersal fishes than the Outer Bay. Juvenile and adult Pacific sand lance, Pacific herring, osmerids (family Osmeridae), and sculpins all were more abundant in the Inner Bay. Gadids (family Gadidae) were the only schooling fish taxa more abundant in the Outer Bay (Abookire et al., 2000). These studies demonstrate that Kachemak Bay is an important nursery area for many juvenile groundfishes (especially flatfishes) and juvenile Pacific sand lance.

To better evaluate the potential effects of offshore oil and gas development, we used the National Marine Fisheries Service Geographic Information System maps to categorize relevant managed-fish species presence in eight subregions in the Cook Inlet region. Subregions are shown on Map 3. Table III B-1 identifies the species presence within these subregions. In a few cases, Mecklenburg, Mecklenburg, and Thorsteinson. (2002) was used to supplement the information. Specific habitat types and characteristics occupied by each species are incorporated herein by reference (North Pacific Fishery Management Council, 1998, 1999). Table III.B-1 lists the managed-fish species and prey species identified by the North Pacific Fisheries Management Council for the Gulf of Alaska, along with the depths at which they are found. Those noted with the term “off shelf” are in waters deeper than 300 meters and beyond the area being analyzed for these oil and gas lease sales.

Some managed finfish and shellfish species and their general habitats are described in Section III.B.2.a-c (Fisheries Resources). These include Pacific herring, Pacific sand lance, eulachon, capelin, salmon, Pacific cod, Pacific halibut, walleye pollock, Pacific Ocean perch, sable fish, halibut, scallops, razor clams, shrimp, and crabs. Essential fish habitats for chiefly sable fish, Atka mackerel, skate, Pacific herring, rainbow smelt, pollock, several species of rockfish, halibut (technically not EFH, but nonetheless important to the region), Dover and yellowfin sole, Pacific Ocean perch, and weathervane scallop are shown in Maps 3 through 10 and 21. Finfishes that inhabit the entire study area are not shown on the maps include walleye pollock adults, arrowtooth flounder, sculpin, and, Pacific cod. Several other finfishes are absent from the maps, because they inhabit all of the study area except for the northern portion of lower Cook Inlet. They include halibut, flathead sole, rock sole, and walleye pollock eggs. The salmon shark, sleeper shark, and spiny dogfish chiefly inhabit neritic waters (less than 200 meters in depth), but also may occur in oceanic waters (greater than 200 meters in depth) of the region. Octopus may inhabit a variety of substrate types and lower portions of the water column on the shelf and upper slope of the Gulf of Alaska. Squid are more pelagic in nature than octopi and inhabit pelagic waters of the shelf, slope, and basin of the Gulf of Alaska. Overall, limited information is documented regarding the specifics of EFH for many managed species; that information known is summarized in North Pacific Fishery Management Council (1998, 1999).

III.B.3.b(1) Prey and Prey Habitat

The forage fish identified for the Gulf of Alaska Fisheries Management Plan for EFH are identified in Table III.B-1.

Ecologically, the Pacific herring, Pacific sand lance, and walleye pollock are the most important forage fish as well as the most important (by numbers) managed fish in the western Gulf of Alaska. Another common group of forage fish in the central Gulf of Alaska are the smelts (*Osmeridae*), including capelin, eulachon, and rainbow smelt, which inhabit neritic waters of the continental shelf. Deep-sea smelts (*Bathylagidae*) and lanternfish (*Myctophidae*) chiefly inhabit areas seaward of the continental shelf. Only one species of bristlemouth (*Gonostomatidae*), the black bristlemouth, is common in the Gulf of Alaska, and inhabits areas seaward of the continental shelf break (Mecklenburg, Mecklenburg, and Thorsteinson, 2002). Pricklebacks (*Stichaeidae*), gunnels (*Pholidae*), and sandfish (*Trichodontidae*) inhabit coastal and offshore waters of the continental shelf. Euphausiids, also called krill, are important prey for baleen whales and juveniles of many managed fish species.

There are a variety of processes influencing the patterns of community structure and prey availability in the Gulf of Alaska's large marine ecosystem that includes Cook Inlet. Bottom-up processes largely relate water temperature with crustacean densities and, thereby, influence predatory fishes higher in the trophic web. Conversely, top-down processes also contribute to the community structure of the region. Piscivorous predators such as sea birds, marine mammals, and other fishes, including sharks, may limit or slow the ability of depressed forage fish populations from increasing. For example, the total biomass of all forage taxa, including juvenile pollock, may now be limiting because of the enormous food demands of adult groundfish, which outweigh those of sea birds and marine mammals by 1-2 orders of magnitude (Livingstone, 1993; Yang, 1993; Hollowed et al., In press; all as cited in Anderson and Piatt, 1999.).

It is important to note that the inshore ecosystem of the Gulf of Alaska has undergone a shift from an epibenthic community dominated largely by crustaceans to one now dominated by several species of fishes (Anderson and Piatt, 1999). Analysis of historical data revealed that the nearshore Kachemak Bay fish community changed significantly between 1976 and 1996, showing increased diversity and abundance in several taxa, notably gadids, salmonids, pleuronectids, and sculpins (Robards et al., 1999). Ocean climate in the Gulf of Alaska cycles between warm and cold regimes on a multidecadal time scale (Francis et al., 1998; McGowan et al., 1998; both cited in Anderson and Piatt, 1999). During the last reversal from a cold (1947-1976) to a warm regime (1977-present), the Aleutian Low pressure system shifted south and intensified, leading to stronger westerly winds and warmer surface waters in the Gulf of Alaska. Biological consequences included a marked improvement in groundfish recruitment and sharply increased Pacific salmon catches in Alaska (Anderson and Piatt, 1999 citing Francis and Hare, 1994). In contrast, some forage fish populations collapsed to the detriment of predators such as sea bird and marine mammal populations (Piatt and Anderson, 1996; Merrick et al., 1997). It appears that forage species such as pandalid shrimp and capelin may be leading indicators of decadal-scale changes in northern marine ecosystems because of their short lifespans and low trophic levels (Anderson and Piatt, 1999). It is likely that one or more ocean climate-regime shifts will occur during the lifetime of the Proposed Action.

III.B.3.b(2) Habitat Areas of Particular Concern

Habitat Areas of Particular Concern (HAPC) are those areas of special importance that may require additional protection from adverse activities. The North Pacific Fishery Management Council recognizes certain biotope types in Alaska to be of special importance. These include living substrates in shallow and deep waters and freshwater habitat used by anadromous fish. The Council has stated that nearshore, shallow algal substrates may be included as habitat requiring protection in the future, given their importance for certain fish, such as Pacific herring and Pacific sand lance. The Council is preparing an EIS that includes procedures for identifying HAPC. Presently, Cook Inlet has not been surveyed for HAPC, and procedures are needed for delineating HAPC before such mapping can be completed.

Living substrates in shallow and deep waters (i.e., corals, sponges, mussels, rockweed, and kelp) and freshwater habitats used by anadromous fish (for which there is a commercial fishery) were identified by the North Pacific Fisheries Management Council as HAPC (www:afsc.noaa.gov/groundfish/HAPC/HAPC.htm). The only living substrates identified in the North Pacific Fishery Management Council tables are kelp forests used by Atka mackerel eggs and adults. Cook Inlet, Shelikof Strait, and Kennedy Entrance have few notable regions of eelgrass and kelp except within Kachemak Bay (Otis and Gretsch, 2002, pers. commun.). The Barren Islands and Kachemak Bay nearshore habitats are important to Pacific sand lance (Robards et al., 1999). There are areas of submerged vegetation that are important spawning habitat to Pacific herring in Kamishak Bay that may need additional protection.

Pacific salmon are common anadromous fishes that migrate through Cook Inlet to freshwater watersheds feeding into the larger estuary. First-order streams (which flow directly into saltwater) are identified on Map 21.

Heifetz (2002) reviewed coral distributions in Alaska. Corals in the proposed sale area are mostly Gorgonian and cup corals; the associated managed-fish species are primarily rockfish, Atka mackerel, gadoids (cod), and flatfish (halibut and sole).

III.B.4. Endangered and Threatened Species

III.B.4.a. Introduction

Species that are listed as either threatened or endangered under the Endangered Species Act (ESA) of the United States, species that are currently listed as candidates for listing under that Act, and species that were recently removed from the list of species protected under the ESA, occur in areas within and/or near the proposed OCS Cook Inlet lease sale area.

Congress enacted the ESA "…to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved" and "to provide a program for the conservation of such…species."

To achieve this general goal, Congress specified the responsibilities of Federal Agencies prior to taking actions that might affect threatened or endangered species. Thus, Section 7(a)(2) of the ESA specifies:

> Each federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded or carried out by such agency is not likely to jeopardize the continued existence of any endangered species and threatened species or result in the destruction or adverse modification of habitat of such species which is determined…to be critical, unless such agency has been granted an exemption for such action…pursuant to subsection (h) of this chapter.

Under Section 3 of the ESA (16 U.S.C. 1531-1544), as amended, an "endangered species" is defined as "any species which is in danger of extinction throughout all or a significant portion of its range…" and a "threatened species" is "…any species which is likely to become endangered within the foreseeable future throughout all or a significant part of its range."

In the following section, we provide information about species listed under the ESA. In some cases, we discuss primarily certain populations or subspecies of biological species.

Section 3(15) of the ESA, as amended, states: "(T)he term "species" includes any subspecies of fish or wildlife or plants, and any distinct population segment of any vertebrate fish or wildlife which interbreeds when mature" (16 U.S.C. § 1532). Thus, under the ESA, distinct population segments and subspecies are included along with biological species in the definition of "species," and such entities can be listed separately from other subspecies and/or distinct population segments of the same biological species. In many cases, one or more, but not all, subspecies (for example, previously, the Aleutian Canada goose) or designated distinct population segments (for example, the Southwest Alaska Distinct Population Segment of the northern sea otter) of a biological species will be given, or considered for, protected status under the ESA, but other population segments of the biological species will not (for example, the Southcentral Alaska stock of sea otters). Relatedly, different distinct population segments of the same biological species can be listed under the Act but have different status (for example, the western and the eastern U.S. population stocks of Steller sea lions).

Ten "species" (2 of which belong to the same biological species) that are listed as either threatened or endangered under the ESA can occur within or near the proposed Cook Inlet lease-sales area. Additionally, two species are candidates for listing under the ESA, two were delisted within the last 5 years, and one may be designated as a candidate in the near future.

In the following, we also refer to and discuss specific "population stocks" of threatened and endangered marine mammal species. The Marine Mammal Protection Act mandates management of marine mammal population stocks. Under Section 3 of the Marine Mammal Protection Act, the "…term 'population stock' or 'stock' means a group of marine mammals of the same species, or smaller taxa in a common spatial arrangement, that interbreed when mature" (16 U.S.C. § 1362 (11)). "Population stock" (usually referred to simply as "stock") designations of many groups of marine mammals have changed over the past decade, in large part due to focused efforts to define the stocks coupled with the availability of relatively new tools from molecular genetics. Thus, because of new information, many species of marine mammals that were formerly (for example, at the time of the final EIS for Cook Inlet Sale 149 [USDOI, MMS, Alaska OCS Region, 1995]) treated as if comprised of only a single stock, now may be subdivided into multiple stocks. In the cases of marine mammals for which separate stocks have been delineated, we focus our description and evaluation of potential effects on those stocks that may occur within or near the proposed Cook Inlet multiple-sales area. However, we bring in information on the biological species as a whole if it enhances the understanding of the relevant stock(s) or aids in evaluation of the significance of any potential effects on the stock that occurs within or near the program area.

The "species" that are listed as either endangered or threatened, that are proposed for listing, that have been delisted within the last 5 years, or that are currently designated as candidates for listing under the ESA that are known to occur in or near the proposed Cook Inlet multiple-sales area and, thus, that potentially may be affected by activities within the multiple-sales area, are as follows (the species also are listed in Table III.B-2 along with their scientific names):

- Steller sea lion (Western U.S. Stock) – Endangered
- Steller sea lion (Eastern U.S. Stock) – Threatened
- Blue whale – Endangered
- Fin whale – Endangered
- Humpback whale – Endangered
- Northern Right whale – Endangered
- Sei whale – Ezndangered
- Sperm whale – Endangered
- Beluga whale (Cook Inlet stock) – Candidate
- Steller's eider (Alaska breeding population) – Threatened
- Short-tailed albatross – Endangered
- Northern sea otter (Southwest Alaska Distinct Population Segment) – Candidate
- Aleutian Canada goose – Delisted 2001
- American peregrine falcon – Delisted 1999

There also is designated critical habitat for Steller sea lions within and near the proposed multiple-sales area. Under Section 3 of the ESA, the term "critical habitat" for a threatened or endangered species is defined (16 U.S.C. 1532(5)(A)) as:

> (i) the specific areas within the geographic area occupied by the species, at the time it is listed…, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management consideration or protection; and (ii) the specific areas outside of the geographical areas occupied by the species at the time it is listed…, upon a determination by the Secretary that such areas are essential to the conservation of the species.

In this EIS, we provide information on this designated critical habitat and analyze whether the proposed action is likely to have adverse effects on it. At present, there is no other designated critical habitat for any threatened or endangered species within or near the proposed multiple-sales area.

In the following section, we provide available information on aspects of the biology, history, regulatory history, etc. of each species that facilitates assessing potential effects of the Proposed Action on them. Guidance for the content of this section was taken from the Endangered Species Handbook (USDOI, Fish and Wildlife Service and and National Marine Fisheries Service, 1998). Levels of information presented for different species differ, primarily because the level of information available differs greatly among species. Slightly less detail is provided for species that rarely inhabit areas in or near the proposed multiple-sales area than for those that inhabit such areas year-round or that can seasonally be expected to occur with regularity.

At the time of finalization of this EIS, Kittlitz's murrelets have not been designated as a candidate species. Thus, we have placed our baseline information and our analysis of potential effects on Kittlitz's murrelets in Appendix G.

III.B.4.b. Marine Mammals

A minimum of 10 stocks (of nine biological species) of threatened, endangered, or candidate species of marine mammals could occur within and/or near the proposed sales area. We qualify the number because, as will become apparent in the following discussions, the population structure of many of the marine mammals is not well understood and, in many instances, is undergoing frequent revision with the acquisition of new information.

In the following sections, we use certain terms that are defined in the Marine Mammal Protection Act and that have specific meaning to marine mammal populations. In addition to the term "population stock" which we discuss in our introductory remarks to this section, these include the terms "depleted" and "Optimal Sustainable Population."

The Marine Mammal Protection Act provides the Fish and Wildlife Service and the National Marine Fisheries Service with the authority to declare a stock of marine mammals "depleted" (16 U.S.C. § 1362(1)). The definitions of depleted and Optimum Sustainable Population are linked. Optimal Sustainable Population is defined as follows: "[W]ith respect to any population stock, the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element" (16 U.S.C. 1362(8))."

A population stock is considered to be depleted if it is below its Optimal Sustainable Population range.

The term "strategic stock" is defined in the 1994 amendments to the Marine Mammal Protection Act as "…a marine mammal stock (A) for which the level of direct human-caused mortality exceeds the potential biological removal level; (B) which…is declining and is likely to be listed as a threatened species…within the foreseeable future; or (C) which is listed as a threatened species or endangered species…, or is designated as depleted…" under the Marine Mammal Protection Act (16 U.S.C. 1362).

For additional detailed and up-to-date information on the current status, distribution and abundance, population trends, sources of mortality, potential biological removal, history, and current habitat concerns for most of the following marine mammal stocks, we refer the reader to the 2002 Alaska Marine Mammal Stock Assessments 2002 (Angliss and Lodge, 2002). Under 1994 amendments to the Marine Mammal Protection Act, the Fish and Wildlife Service and the Nationa Marine Fisheries Service were required to prepare stock assessments for all marine mammal stocks under their jurisdiction. These reports were required to be based on the best scientific information available and were required to provide the following: the geographic range of the affected stock; a minimum population estimate; productivity rates and population trends; estimates of annual human-caused mortality and sources of serious injury; categorization of the status of the stock as either unlikely to be reduced below its Optimal Sustainable Population or as "strategic"; a description of commercial fisheries that interact with the stock; and an estimate of the potential biological removal (16 U.S.C. § 1386). These stock assessments are to be reviewed and updated annually for strategic stocks and for stocks for which significant new information is available and updated every 3 years for all other stocks (16 U.S.C. § 1386). In the following discussions, we identify additional sources of comprehensive, detailed information available for each population stock (for example, recovery plans, status reviews, species accounts, conservation plans) and refer interested readers to these documents.

III.B.4.b(1) Beluga Whale (Cook Inlet Stock) (*Delphinapterus leucas)* – Candidate

III.B.4.b(1)(a) Summary

The Cook Inlet beluga whale is a geographically isolated, genetically differentiated population of beluga. At present, at least some members of this population apparently tend to stay much or all of the year in the inlet. Thus, this stock is vulnerable to anthropogenic changes in that environment. Cook Inlet belugas prey on a wide variety of marine organisms, including species of fish that enter the inlet from the open ocean. The known summer distribution of this population apparently has shrunk since the mid-1970's (Rugh, Shelden, and Mahoney, 2000), and sightings in the lower inlet and offshore areas are now rare. Data indicate population size may have declined by nearly 50% between 1994 and 1998 (Hobbs, Rugh, and DeMaster, 2000) due primarily to a high (Mahoney and Shelden, 2000) and unsustainable take by Alaska Native hunters. This hunt is now being regulated. At present, documented zones of high summer use include areas in or near the Susitna Delta, Knik Arm, and Point Possession in the extreme upper Inlet. In winter, belugas are seen in the central inlet, but whales are more dispersed than in the summer and sightings are fewer. Belugas also can occur within the proposed Cook Inlet sales area, although recent sightings are rare. Sightings in areas that are "downstream" of the proposed activities are rare at present. Beluga whales have acute hearing, which they can use to echolocate and communicate.

Because they are resident within Cook Inlet at least much of the year, and because there is a relatively large amount of information about this population, we provide considerable detail about the biology and status of the Cook Inlet beluga. We refer readers to the recently released Volume 62(3) of the scientific journal *Marine Fisheries Review*, all of which is focused on the Cook Inlet beluga whales, the Status review in the June 22, 2000, *Federal Register* (65 *FR* 38778), the draft EIS recently prepared by the National Marine Fisheries Service (2000), and to the Recommended Decision by the U.S. Administrative Law Judge (Administrative Law Judge, 2002) on the proposed rule limiting the subsistence harvest of Cook Inlet belugas.

III.B.4.b(1)(b) General Description

Beluga whales are odontocetes, or toothed whales. They lack a dorsal fin. Pups are dark gray to brownish gray (Calkins, 1983), and their color typically lightens with age (National Marine Fisheries Service, 2000). Thus, adults typically are light colored, (white to yellow-white); however, Burns and Seaman (1986) found that females estimated to be 21 years of age could retain some gray coloration. They are rather small, reaching lengths typically about 12-14 feet (3.66-4.27 meters) [ranging up to 16 feet (4.9 meters) (National Marine Fisheries Service, 2000)] or 20 feet (6.1 meters) [Native hunters cited in National Marine Fisheries Service, 2000] in length. Based on data in Nowak (1991), the National Marine Fisheries Service (2000) summarized that males weigh about 1,500 kilograms (3,307 pounds), and females weigh about 1,360 kilograms (2,998 pounds). Belugas rely on a thick layer of blubber for protection from the cold waters of their environment. This blubber, which can comprise 40% of their body mass (Sergeant and Brodie, 1969) and be in excess of 9 centimeters (3.54 inches) thick (National Marine Fisheries Service, 2000), also stores energy (National Marine Fisheries Service, 2000).

III.B.4.b(1)(c) Population Stock Structure and Current Stock Designations

Data indicate that the belugas in Cook Inlet are a distinct population, the most isolated of five populations of beluga in Alaska coastal waters (Hazard, 1988; Hill and DeMaster, 1998). The Cook Inlet beluga is designated as a separate population stock by the National Marine Fisheries Service (Angliss and Lodge, 2002). Other population stocks are in Bristol Bay, Norton Sound, the eastern Chuckchi Sea, and the Beaufort Sea (O'Corry-Crowe et al., 1997). Virtually no belugas are reported between Cook Inlet and Bristol Bay. Based on genetic data, O'Corry-Crowe et al. (1997) concluded it is likely there is little or no interchange of Cook Inlet belugas with other beluga populations. Available evidence indicates that the Alaska Peninsula is an effective barrier of regular interchange. Both groups petitioning for the listing of the Cook Inlet beluga whale under the ESA and the National Marine Fisheries Service concluded that the Cook Inlet beluga whale is the only population of beluga to inhabit the Gulf of Alaska (65 *FR* 38778). Based on this information, the National Marine Fisheries Service has concluded that Cook Inlet beluga whales are "…a distinct population segment and, therefore, a species" as defined "under section 3(15) of the Endangered Species Act" (65 *FR* 38778).

III.B.4.b(1)(d) Current Endangered Species Act Status and Protective Legislation

In March 1999, the National Marine Fisheries Service received two petitions to list this population as endangered under the Endangered Species Act with the immediate threat identified being the high harvest by Alaska Natives. The National Marine Fisheries Service determined the petitions contained substantial scientific or commercial information indicating the petitioned action might be warranted (64 *FR* 17347). On May 21, 1999, P.L. 106-31 established a temporary enforceable mechanism to control the Native harvest by prohibiting harvest unless authorized by a cooperative agreement between the National Marine Fisheries Service and affected Alaska Native organizations. This law remained in effect until October 1, 2000. In 1999 and 2000, there was no reported take of Cook Inlet beluga whales. The Cook Inlet stock of beluga whales was designated as depleted under the Marine Mammal Protection Act on May 31, 2000 (65 *FR* 34590) based on (65 *FR* 38778) a determination by the National Marine Fisheries Service that the stock is below its Optimum Sustainable Population Level. On June 22, 2000, the National Marine Fisheries Service published a determination that listing of the Cook Inlet stock of beluga whales under the Endangered Species Act was not warranted at that time. The stock is currently listed as a Candidate species under the ESA (65 *FR* 38778). In December 2000, the moratorium of subsistence harvest of Cook Inlet beluga, unless authorized under a cooperative agreement between the National Marine Fisheries Service and affected Alaska Native organizations, was made permanent (P.L. 106-553, 1(a)(2), 114 Stat. 2762 (December 21, 2000).

On October 4, 2000, the National Marine Fisheries Service (65 *FR* 59164) proposed regulations limiting the subsistence harvest of Cook Inlet beluga whales. In the proposed rule, the National Marine Fisheries Service proposed that:

- Subsistence harvest can occur only under an agreement between the National Marine Fisheries Service and an Alaska Native organization pursuant to section 119 of the Marine Mammal Protection Act.
- Subsistence harvest shall be limited to no more than 2 strikes per year until the stock is no longer considered depleted under the Marine Mammal Protection Act.
- The sale of Cook Inlet beluga products is prohibited.
- All subsistence hunting will occur after July 1 of each year.
- Newborn calves and adult whales with maternally dependent calves cannot be harvested.

On March 29, 2002, a United States Administrative Law Judge issued a recommended decision regarding the proposed rule (67 *FR* 30646; Administrative Law Judge, 2002). The judge recommended modifying the National Marine Fisheries Service proposed rule to allow harvesting of up to six Cook Inlet beluga whales to be taken over a period of 4 years between 2001 and 2004. Four of the strikes, not to exceed one per year, are allocated to the Native Village of Tyonek, and the remaining two strikes will be allocated among hunters under provisions of the co-management agreements between the National Marine Fisheries Service and Alaska Native Organizations.

In May 2002, the National Marine Fisheries Service (2002) issued an environmental assessment finding that the harvest of two belugas during the year 2002, as specified in the agreement, would not cause adverse impacts to any species listed under the Marine Mammal Protection Act or the ESA and would not significantly impact the overall quality of the human environment. The National Marine Fisheries Service entered into a cooperative agreement with the Cook Inlet Marine Mammal Council in 2002. This agreement specifies conditions, time periods, locations, and other aspects of the permitted subsistence hunt of beluga. After the National Marine Fisheries Service's determination not to list the Cook Inlet stock of belugas under the ESA, Trustees for Alaska and others filed suit challenging the Secretary of Commerce's and the National Marine Fisheries Service's decision to list the Cook Inlet beluga as "depleted" under the Marine Mammal Protection Act, but not as "threatened" or "endangered" under the ESA. In August 2001, a U.S. District Court Judge ruled in favor of the Government. The plaintiffs have appealed, and the appeal has not yet been heard. The Cook Inlet population of beluga whales is listed by the State of Alaska as a Species of Special Concern.

III.B.4.b(1)(e) Historical and Current Habitat Associations, Abundance, and Distribution

III.B.4.b(1)(e)1) Abundance

All available information indicates population abundance of beluga whales in Cook Inlet recently has declined, primarily due to high and unsustainable levels of take by Alaskan Native hunters. The population now is considered to be below its Optimal Sustainable Population. However, there is considerable uncertainty about current population size, past population size, and the carrying capacity of the stock (see Administrative Law Judge, 2002 and references cited therein).

The National Marine Fisheries Service (2000) summarized that prior to 1994, many of the counts of beluga in Cook Inlet were incomplete, nonsystematic, and highly variable. They concluded that the aerial survey in 1979 by Calkins (1989) probably provides the best available data for estimating the carrying capacity of the inlet. This count resulted in a minimum direct count of 479 (or 471, see comments on page 27 in Administrative Law Judge, 2002) belugas. After applying a correction factor of 2.7 to account for belugas that were submerged, Calkins (1989) derived a minimum abundance estimate of 1,293 whales. However, D. DeMaster (cited in Administrative Law Judge, 2002) stated that none of the four independent estimates, including the aforementioned estimate of carrying capacity, were fully reliable. Calkin's survey apparently did not cover certain "critical" areas (National Marine Fisheries Service, Alaska Oil and Gas Assoc. cited in Administrative Law Judge, 2002).

Information about long-term abundance trends is not available because of the variety and lack of documentation in many of the previous surveys. Hobbs, Rugh, and DeMaster (2000) stated that "…it is inappropriate to attempt abundance-trend analyses based on counts from 10- to 30-year-old studies with very little supporting documentation."

The National Marine Fisheries Service (described in Rugh, Shelden, and Mahoney, 2000) conducted thorough annual surveys of the coastal regions of the inlet [1,350 kilometers (838.9 miles) of shoreline] (Moore and DeMaster, 2000) in June and/or July of 1993-2000. Approximately most of the area within 3 kilometers (~1.86 miles) of shore was covered (Rugh, Shelden, and Mahoney, 2000). Surveys also included about 1,000 kilometers (~621 miles) of transects across the central inlet to provide coverage of an estimated 13-33% of the entire inlet (Rugh, Shelden, and Mahoney, 2000). Based on the aforementioned surveys, Hobbs, Rugh, and DeMaster (2000) calculated abundances (see Table III.B-3) of beluga whales in Cook Inlet for each year of the survey. These abundance estimates include correction for both whales that were submerged during overflight (availability bias) and for whales that were at the surface but were missed (detection bias). They also follow analyses undertaken to estimate the probability that whole groups were missed and to correct estimates to account for missed groups. Hobbs, Rugh, and DeMaster (2000) state that these estimates replace previously released estimates for 1994 and 1999. R. Hobbs of the National Marine Mammal Laboratory (Hobbs, 2003, pers. commun.) cautions against overinterpretation of these survey data. While the apparent change in estimated abundance between the summers of 1999 and 2000 was within the amount of change that could be expected, based on the confidence intervals for the estimates, it is clear that beluga populations are not capable of a real increase in abundance of nearly 19% over the time period of a single year. Hobbs, Rugh, and DeMaster (2000) reported that Monte Carlo simulations indicated that there was a 47% probability that from June 1994 to June 1998, there was a 50%

depletion of abundance of belugas whales in Cook Inlet (see detailed analyses in Hobbs, Rugh, and DeMaster, 2000).

Data indicate the decline resulted primarily from a high and unsustainable take of Cook Inlet beluga by Alaska Native hunters (National Marine Fisheries Service, cited in Administrative Law Judge, 2002), but there may be other factors significantly contributing to the decline (National Marine Fisheries Service, D. DeMaster, J. Blatchford, D. Goodman, cited in Administrative Law Judge, 2002). During this period, the average reported harvest was 72 whales per year (Mahoney and Shelden, 2000). Moore and DeMaster (2000) calculated that this take represented 21% of the best estimate of abundance in 1998 (347, standard error = 101, coefficient of variation = 0.29) and was about five times the calculated (Hill and DeMaster, 1998) potential biological removal of 14 animals for the population at that abundance. Data on the intrinsic rate of growth for Cook Inlet beluga whales is unknown (National Marine Fisheries Service cited in Administrative Law Judge, 2002) as is the carrying capacity for the stock (National Marine Fisheries Service and D. Goodman, cited in Administrative Law Judge, 2002).

As is evident from information on distribution, summarized below, there is no evidence that the belugas in Cook Inlet have dispersed in response to the Native harvests (Laidre et al., 2000; Rugh, Shelden, and Mahoney, 2000).

III.B.4.b(1)(e)2) Distribution

As a species, beluga whales are circumpolar in distribution inhabiting subarctic and arctic waters. In Alaska, the known range of the beluga extends from Yakutat to the Alaska-Canadian border in the Beaufort Sea. Available information indicates that beluga populations are variable in their relative mobility. Some populations undertake long seasonal migrations whereas other populations stay in a relatively small area year-round (National Marine Fisheries Service, 2000).

Moore et al. (2000) stated that the strongest influence on the distribution and relative abundance of belugas in Cook Inlet probably is prey availability. In summer, the belugas congregate in shallow, relatively low salinity and warm areas near river mouths in upper Cook Inlet. These areas have relatively good prey availability and low predator occurrence. Moore et al. (2000) defined this as their primary habitat. Moore et al. (2000) used summer distribution patterns, as ascertained from the surveys conducted by Rugh, Shelden, and Mahoney (2000), to summarize Cook Inlet beluga habitat preferences into three regions (see Figure III.B-2, reproduced from Figure 1 of Moore et al., 2000) termed areas of high (Region 1), moderate (Region 2), and low (Region 3) beluga occurrence. This figure needs to be interpreted cautiously, however, as it summarizes use only during a 2-month (June and July) period. Additionally, survey coverage in the upper inlet and in all nearshore areas is much greater than in offshore areas in the central, and especially in the lower inlet.

After evaluation of previous surveys and other information, as well as analysis of the aerial surveys, Rugh, Shelden, and Mahoney (2000:6) concluded, "Over the past three decades, summer distribution has shrunk such that sightings now only rarely occur in lower Cook Inlet and in offshore areas." Rugh, Shelden, and Mahoney (2000) reported that at present, 96%-100% of the sightings reported are concentrated in a few dense groups in a shallow area in upper Cook Inlet near river mouths. Rugh, Shelden, and Mahoney (2000) reported that the largest concentration of belugas (151-288 individuals counted) was in the Susitna River Delta and/or in Knik Arm. Smaller numbers (17-49 whales) were consistently observed between the Chickaloon River and Point Possession. Densities within a group were significantly higher in the Susitna Delta (mean of 68.6 whales per square kilometer; with an SEM = 7.9) and Knik Arm (mean of 54.8 whales per square kilometer; with an SEM of 14.9) than in Chickaloon Bay (mean of 29.4 whales per square kilometer; with an SEM of 6.6).

Most of the whales sighted during aerial surveys were in only 5-11 groups. Group sizes observed appeared to vary by area. Using only one survey day per year, 71% of 17 groups observed in the Susitna Delta contained more than 20 individuals. However, even in other locations in upper Cook Inlet, relatively few (24% of 33) large groups were seen, and none of the seven groups observed in lower Cook Inlet were large (1-14 whales each) (Rugh, Shelden, and Mahoney, 2000).

Belugas often go into the rivers, such as the Kenai and the Susitna, after fish. Native hunters reported to Huntington (2000) that belugas have ascended the Beluga River to Beluga Lake.

Beluga whales disperse throughout much of the upper inlet by the end of June (National Marine Fisheries Service, 2000). Moore et al. (2000) reported that dispersal of the large groups is not observed until later in the summer. By mid- to late October, belugas travel south from the upper inlet, but sightings near Anchorage continue into November (National Marine Fisheries Service, 2000). Belugas are sighted in the central inlet in winter, but sightings are few. Data from nine whales instrumented with satellite transmitters showed all but one of the whales remained in the upper inlet, rarely south of the Forelands. In September, one female whale ventured as far south as Chinitna Bay. Later data on this whale were not available.

In surveys prior to 1995, smaller groups (fewer than 20 whales) were observed at other locations including Kachemak Bay, Turnagain Arm, Redoubt Bay (Big River), and Trading Bay (McArthur River). Native hunters reported that there were great numbers of belugas in Trading Bay up until 10-15 years ago, often going up the McArthur River (Huntington, 2000). Beluga were not observed in these areas after 1995 except for one whale observed in Tuxedni Bay in 1997 and a dead whale in the middle of the lower inlet in 1998 (Rugh, Shelden, and Mahoney, 2000). Speckman and Piatt (2000) reported that belugas typically used other bays, such as Tuxedni and Chinitna, prior to the 1990's. At present, sightings rarely are reported from lower Cook Inlet or from offshore areas.

Laidre et al. (2000) examined surveys in the Cook Inlet and Gulf of Alaska region as far back as 1936. They summarized that during more than 150,000 kilometers (~93,210 miles) of dedicated survey effort in the Gulf of Alaska, there were only four beluga sightings (of 5 individuals) out of 23,000 individual cetaceans observed. Of nearly 100,000 individual cetaceans reported in the Platforms of Opportunity database, only five sightings of 39 individual beluga whales were reported. Nineteen other sightings (of greater than a total of 260 individuals) have been reported without information about effort or other cetaceans observed. Laidre et al. (2000) summarize that of 28 reported sightings (not number of individuals) of beluga outside of Cook Inlet "9 were near Kodiak Island, 10 were in or near Prince William Sound, 8 were in Yakutat Bay…, and 1…was well south of the Gulf." Four of the sightings in the Kodiak/Shelikof Strait region were between 1997 and 2000. All but one of these sightings were of one individual. One sighting of five belugas in 1999 was near Gore Point. Of the sightings in Prince William Sound region, five sightings (ranging from 1-8 individuals) were in the late 1990's. In Yakutat Bay, five of the sightings (ranging from 2-11 individuals) were observed from 1993-2000 (see Laidre et al., 2000:Table 1).

The sightings of belugas outside of Cook Inlet usually have been of a rather small number of individuals (1-26, including 5 juveniles) (see Laidre et al., 2000:Table 1). However, in 1983 Calkins (1986) observed approximately 200 belugas in Prince William Sound near Knight Island.

With respect to winter habitat and/or other use of areas outside of the inlet, the National Marine Fisheries Service (2000:17) summarized that "It is presently unknown whether this stock migrates seasonally from Cook Inlet and, if so, where it goes." Information from sightings and from the small number of satellite-tagged individuals indicates that at least some individuals stay year-round in the inlet. However, in previous years belugas presumed to be from the Cook Inlet stock have been observed outside of Cook Inlet. It is unknown how many individuals travel to the lower inlet (although if they are there, they are rarely observed), or leave the inlet altogether in most years, or what factors (for example, age, sex, reproductive status, ice conditions, etc.) may be associated with winter distribution patterns and the tendency for individuals to stay in or leave the inlet.

III.B.4.b(1)(f) Foraging Ecology

Moore et al. (2000:68) reports that the "…diet of belugas in Cook inlet is largely unknown." In other populations, belugas have been documented to eat a wide variety of prey (National Marine Fisheries Service, 2000; Moore et al., 2000) including fish, crustaceans, and cephalopods (Seaman, Lowry, and Frost, 1982). They sometimes hunt cooperatively to trap and/or to herd their prey (National Marine Fisheries Service, 2000; Native hunters as reported by Huntington, 2000). Reported prey species include capelin, cod, herring, smelt, flounder, sole, sculpin, lamprey, salmon, octopus, crabs, shrimp, clams, mussels, snails, squid, sandworms (Klinkhart, 1966; Haley, 1986; Perez, 1990), and euchalon (hooligan) (National Marine Fisheries Service, 2000). Native hunters in the Cook Inlet region reported to Huntington (2000) that belugas will eat any fish they can.

The National Marine Fisheries Service (2000:19) reports that euchalon, a fish with high (up to 21%) oil content, "…is undoubtedly a very important food source for beluga whales in Cook Inlet." The stomachs of belugas near the Susitna River during spring have "been packed with euchalon" (National Marine Fisheries Service, 2000:19). These fish migrate into the upper Inlet in May. Major spawning runs of euchalon occur in May and then in July in the Susitna River. The National Marine Fisheries Service (2000) also identified salmon smolt as an important spring prey item for beluga in Cook Inlet. The National Marine Fisheries Service summarized that all five species of salmon occur in the upper Inlet with pink and chum being most numerous during June and July (when the surveys are conducted).

Hunters reported that beluga have been seen off Salamatof Beach, north of Kenai, in March, feeding on Pacific herring (*Clupea pallasi*). They report that beluga arrive in the upper inlet when the first runs of fish, generally lake whitefish (*Coregonus clupeaformis*), arrive in late April-early May. This observation is similar, but slightly earlier than observations reported to Fall, Foster, and Stanek (1984) and those summarized by Hazard (1988), who reported belugas arrive in the upper inlet in May. The hunters reported that belugas are present in the Kenai River area from April-November, and that they come up the Kenai River after fish. The next species noted in Huntington (2000) include hooligan, king salmon, red salmon, pink salmon, dog salmon, and silver salmon (which they report can remain into November or even into January in the rivers). Native hunters also reported that belugas will eat the following species in the inlet and/or in rivers: lingcod or burbot (*Lota lota*), steelhead trout (*Oncorhynchus mykiss*), whitefish, northern pike (*Esox lucius*), Arctic grayling (*Thymallus arcticus*), starry flounder (*Platichthys stellatus*) (Huntington, 2000), and tomcod during the spring (Fay et al., 1984). Belugas are reported to feed intensively (see details in Huntington, 2000), swallowing fish whole. In captivity, they may consume 40-60 pounds (~18-27 kilograms) of food daily or 2.5-3% of their body weight. Hunters reported (Huntington, 2000) that the blubber of belugas is thin [for example, 2-3 inches (5-8 centimeters)] in the spring prior to fish runs.

III.B.4.b(1)(g) Population Structure

Belugas are social animals. Small aggregations often are observed traveling together or clustered at feeding locations. Rugh, Shelden, and Mahoney (2000) found that while all of the whales in the Susitna Delta were concentrated in either one or two groups in 6/8 years surveyed, in some years four or five smaller groups were observed (see group size information presented in Section III.B.4.b(1)(e)2). Other than mothers with calves, the relationships of these individuals to each other are unknown. Native hunters have reported (Huntington, 2000) that beluga form family groups with white and gray belugas (presumably animals of different ages) traveling together.

III.B.4.b(1)(h) Reproductive Biology

There is little information on the current reproductive characteristics of beluga whales in Cook Inlet. Calkins (1983) summarized calving in Cook Inlet to occur from mid-May-mid-July, but unnamed Alaska Native hunters cited in Huntington (2000) report calving to occur from April-August. No calves were observed during aerial surveys in mid-June (Calkins, 1983). Hunters reported that cows with near-term fetuses have been caught in the Susitna Flats in May (Huntington, 2000). These hunters reported that calving areas include the northern side of Kachemak Bay in April and May, areas off the mouths of the Susitna and Beluga rivers in May, and Chickaloon Bay and Turnagain Arm in the summer (see Huntington, 2000:Figure 2). Katona, Rough, and Richardson (1983) speculated that the relatively warm water from these rivers may be important to neonates. Cows generally give birth to a single calf, but Native hunters (Huntington, 2000) occasionally have observed a female with two calves. Native hunters (Huntington, 2000) reported that few all white belugas are left in the inlet, and gray cows (assumed to be younger, but see Section III.B.4.b(1)(b) - General Description of the Beluga Whale) are having calves.

Age of sexual maturity likely is variable, with reports ranging from 4-7 years (Nowak, 1991) and 10 years (Suydam et al., 1999, cited in National Marine Fisheries Service, 2000) for females and 8-9 (Nowak, 1991) and 8-9 years for males (Suydam et al., 1999 cited in National Marine Fisheries Service, 2000). The latter reports by Suydam are for beluga in the Chukchi Sea. Available information indicates that breeding occurs shortly after calving.

The National Marine Fisheries Service (65 *FR* 38778) summarized that "…there is some evidence that reproduction in the stock has not been compromised…the population consists of a large proportion of juvenile whales, and the age of sexual maturity", apparently referring to gray females with calves, "has apparently decreased in recent years."

III.B.4.b(1)(i) Hearing and Vision

Beluga hearing has been well studied relative to that of the other ESA cetaceans. Available data indicate that the beluga whale has a wide frequency range of hearing (Klishin, Popov, and Supin, 2000). Richardson et al. (1995) reported that they can hear from about 40-75 Hertz (but their sensitivity at these low frequencies are poor) to 80-150 kilohertz in at least some individuals. Klishin, Popov, and Supin (2000) measured the hearing capabilities of an adult male beluga whale using evoked potential methods. The resulting audiogram was U-shaped and similar to other odontocetes, with high sensitivities from 32-108 kilohertz. The lowest threshold obtained (below 54.6 decibels at 54 kilohertz) was a few decibels higher than that found in psychophysical experiments. Klishin, Popov, and Supin (2000) reported their range above 100 kilohertz but reported the range to apparently be a little narrower than those of small cetaceans. Klishin, Popov, and Supin (2000) found that the frequency tuning of the beluga is extremely acute. Turning curves were more acute for belugas than for bottlenose dolphins. Temporal resolution was rather high, but it was slightly lower than in the bottlenose dolphin. Klishin, Popov, and Supin (2000) suggested that the acute frequency tuning may explain why data have suggested belugas have better detection of echolocation signals in noise (Turl, Penner, and Au, 1987) and reverberation (Turl, Skaar, and Au, 1991) than do bottlenose dolphins. Belugas also had acute directional selectivity, a feature also shared with other odontocetes (Klishin, Popov, and Supin, 2000). The National Marine Fisheries Service (2000) summarized that at low frequencies, the hearing of belugas is limited by their hearing threshold and not by ambient noise.

The National Marine Fisheries Service (2000) summarized that beluga whales are reported to have acute vision and are believed to have color vision (Herman, 1980).

III.B.4.b(1)(j) Longevity and Sources of Mortality

Documented natural sources of mortality in Cook Inlet belugas include stranding and predation. However, little is known about natural causes of death in these whales or typical survival rates. Burns and Seaman (1986) reported that beluga may live for 30 or more years.

Belugas in Cook Inlet sometimes become stranded, often during extreme tide fluctuation, and most often in Turnagain Arm. Whales that strand can die from overheating and possibly from stress placed on internal organs and breathing (National Marine Fisheries Service, 2000). The National Marine Fisheries Service (2000) summarized that belugas commonly strand in upper Cook Inlet with an estimated 590 (including 40 whale carcasses found on shorelines that had been harvested for subsistence) whales having stranded in this area since 1988. Mass stranding often coincides with extreme tidal fluctuations and tend to be reported from Turnagain Arm (National Marine Fisheries Service, 2000). The National Marine Fisheries Service (2000) reported 4 adults whales died during a mass stranding of about 60 whales in 1996, and 5 adult whales died during a mass stranding of about 70 whales in 1999. Moore et al. (2000) pointed out that stranding reports do not necessarily represent the actual number of occurrences, because sightings of strandings are opportunistic.

The National Marine Fisheries Service (65 *FR* 38778) summarized that neither disease nor predation is causing the Cook Inlet beluga stock to be threatened or endangered. Available information indicates that orcas, or killer whales, sometimes prey on Cook Inlet beluga, but the level of this predation is unknown. However, several sources indicate it is uncommon. Orcas are known to sometimes enter Turnagain and Knik Arms between Fire Island and Tyonek and near the mouth of the Susitna River. During one stranding in 1993, an orca vomited a large piece of beluga flesh (National Marine Fisheries Service, 2000). Hunters reported to Huntington (2000) that killer whales are rarely seen near belugas, and that predation by killer whales is uncommon.

Necropsies of Cook Inlet beluga have documented several types of parasitic infestations. The nematode parasite *Crassicauda giliakiana* was found to infest approximately 90% of Cook Inlet beluga whales necropsied (National Marine Fisheries Service, 2000). While extensive damage to the kidneys was observed in some instances, Burek (1999) concluded that it is unclear whether functional organ damage would have resulted. An endoparasite (*Pharurus oserkaiae)* has been reported, sometimes at heavy infestation levels in adults, on beluga whales in Cook Inlet. Muscle parasites (*Sarcocystis sp*.) also have been documented in Cook Inlet belugas. Stomach parasites often are present but not at levels likely to cause clinical symptoms (National Marine Fisheries Service, 2000). Bacterial pneumonia and other diseases have been identified as a source of mortality in other beluga populations but are not reported in Cook Inlet (see National Marine Fisheries Service, 2000).

III.B.4.b(1)(k) Contaminant Levels

Becker et al. (2000) compared concentrations of total PCB's, total DDT, chlorodane compounds, hexachlorobenzene (HCB), dieldrin mirex, toxaphene and hexachorocyclohexane in Cook Inlet beluga whale blubber with that from belugas from Point Hope and Mackenzie River (eastern Beaufort Sea) and Point Lay (eastern Chuckchi Sea) in Alaska, from Greenland, Arctic Canada, and from the highly contaminated stock from the St. Lawrence estuary in eastern Canada. Belugas in Cook Inlet and the Arctic had much lower concentrations than belugas in the St. Lawrence estuary. Concentrations detected in Cook Inlet belugas were the lowest of sampled populations (for example, total PCB's averaged 1.49 ± 0.70 and 0.79 ± 0.56 milligrams per kilogram wet mass, and total DDT averaged 1.35 ± 0.73 and 0.59 ± 0.45 milligrams per kilogram ± in males and females, respectively (Becker et al., 2000). Concentrations of the aforementioned compounds in the blubber of male belugas from Cook Inlet were significantly lower than those found in males from the arctic Alaska locations (total PCB's and total DDT were about half). Becker et al. (2000) suggested that the lower levels of these contaminants in Cook Inlet belugas might be due to different age distributions among the animals sampled, different food webs, or differences in contaminant sources. The average estimated ages for the various populations ranged from 7.0 ± 2.5 years (Point Hope 1989 sample) to 19.3 ± 6.6 years (1990's Mackenzie River sample). At an average age of 9.6 ± 3.7 years, the sample of Cook Inlet was the second youngest.

Total chlorodane levels contributed less to the total contaminant burden of Cook Inlet belugas than its relative contribution in other populations. Male belugas had higher concentrations of persistent organic contaminants than did females, a fact Becker et al. (2000) suggested was likely due to a reduction in the contaminant burden of adult females due to mother-infant transfer during pregnancy and lactation.

The levels of copper found in the livers of Cook Inlet belugas were, at 162 ± 130 milligrams per kilogram dry mass, the highest reported for any of the compared populations, significantly higher than those reported for animals from arctic Alaska, and similar to those found in belugas in one of the sites sampled in arctic Canada, East Hudson Bay, and Nastapoka River in the mid-1980's. Becker et al. (2000) summarized that the toxicological significance of these high levels of copper, which is an essential element, are not known.

Cadmium, mercury, and selenium levels in the livers of Cook Inlet belugas were "much lower" than in all of the other beluga populations examined (Becker et al., 2000:97), but methylmercury levels were similar among all three Alaska groups sampled. Liver concentrations of vanadium and silver were lower in the Cook Inlet belugas than in the arctic Alaska beluga populations. However, the silver levels detected in Cook Inlet, Point Hope, and Point Lay belugas were all much higher than those reported for other marine mammals, a finding Becker et al. (2000:97) state suggests "…a species-specific phenomenon."

III.B.4.b(1)(l) Conservation Concerns

Moore and DeMaster (2000), Rugh, Shelden and Mahoney (2000), and others have summarized that the geographic and genetic isolation of this stock, combined with the fidelity of belugas to their summer range makes this stock especially vulnerable to persistent or large harvests (Hill, 1996) and to anthropogenic environmental hazards (Moore et al., 2000). The National Marine Fisheries Service (65 *FR* 38778) summarized that municipal, industrial and recreational activities occurring in the upper inlet has modified habitat for this species and are individually or cumulatively of concern to the National Marine Fisheries Service. Native hunters (Huntington, 2000) identified shore development, increases in fishing and recreational boating, and disturbance from airplanes as factors that may have affected beluga distribution and abundance in Cook Inlet. They also reported that fish in the upper inlet in 1998 had sores on their lips, faces, and heads and had crooked spines. Other concerns were garbage washing up on beaches, effluent from oil wells and other sources of pollution, and an unidentified "bad smell" along the flats.

We also discuss information about existing anthropogenic effects on these whales in the section on cumulative effects (Section V.C.5.f).

III.B.4.b(2) Blue Whale (*Balaenoptera musculus*) – Endangered

III.B.4.b(2)(a) Summary

Blue whales are extremely large baleen whales that are long-lived, slow to mature, and have low reproductive rates. They have recovered slowly from population reduction caused by intensive commercial whaling that began in the mid 1800's and lasted approximately 100 years. Because they tend to inhabit open ocean, there is little know about the population structure, abundance, or current status of these whales in most of their range. Available evidence indicates they are present offshore in the Gulf of Alaska seasonally (approximately July-December) in relatively low, but unknown, abundance, and are unlikely to inhabit the proposed multiple-sales area (see Map 12).

III.B.4.b(2)(b) Basic Description

Blue whales, the largest whales, and the largest animals ever to exist on earth, are a baleen whale found in all oceans (Gambell, 1979; Yochem and Leatherwood, 1985; Mizroch, Rice, and Breiwick, 1984a; Mead and Brownell, 1993). Adults can reach total body lengths of about 33 meters (~109.3 feet) and weigh more than 150,000 kilograms (~330,690 pounds), but blue whales found in the Northern Hemisphere are generally somewhat smaller. In the North Pacific, the largest documented individual was a female of 27.1 meters (89 feet) taken in 1959 by Japanese whalers (J. Gilpatrick cited in Reeves, Silber, and Payne, 1998). They have fringed baleen plates through which they filter small crustaceans.

III.B.4.b(2)(c) Current Subspecies and Stock Definitions

Reeves, Silber, and Payne (1998) pointed out that evaluation of the conservation status of the blue whale is hampered by, and Perry, DeMaster, and Silber (1999a) reported that information on population size and distributions for these subspecies may be unreliable due to, difficulties in distinguishing whales from different populations and different subspecies at sea. Blue whales occasionally interbreed with fin whales in both the North Pacific and North Atlantic (Bérubé and Aguilar, 1998).

Three subspecies of blue whale have been designated (Rice, 1977, 1998a) based (Reeves, Silber, and Payne, 1998) on evaluation of intraspecific variability in body size and geographic distribution: *B. m. musculus* in the Northern Hemisphere; *B. m. intermedia* in the Antarctic; and *B. m. brevicauda*, the "pygmy" blue whale found in the southwestern Pacific Ocean and the subantarctic area of the southern Indian Ocean (Ichihara, 1966; Kato, Miyashita, and Shimada, 1995). Another "resident population" of this species occurs in the northern Indian Ocean (Reeves, Silber, and Payne, 1998). Based on the aforementioned classification, blue whales that occur in the Gulf of Alaska Region are expected to be *B. m. musculus*.

The current population structure and interrelationships of blue whales in different parts of their range is not well studied or defined. There currently is uncertainty and lack of agreement about the number of population stocks of blue whales in the North Pacific in addition to lack of agreement about the population identities of whales in specific areas. Perry, DeMaster, and Silber (1999a:38) reported that there "...is increasing evidence that more than one stock exists within this ocean basin…." Migration routes are not well known (Perry, DeMaster, and Silber, 1999a), and locations of wintering areas for whales that summer in specific areas are somewhat speculative (Jonsgård, 1966; Perry, DeMaster, and Silber, 1999a). For these reasons, it is unclear whether one or more stocks (and which stocks) of blue whales might occur in the Gulf of Alaska region near the proposed sales area and what other areas these same whales might inhabit.

The National Marine Fisheries Service currently recognizes only one stock of blue whales in the eastern North Pacific (Moore, 2002a, pers. commun.). The International Whaling Commission recognizes a single stock in the North Pacific (Donovan, 1991). Reeves, Silber, and Payne (1998) concluded that little information has been available for determining stock identities in the North Pacific, echoing an earlier summary by Mizroch, Rice, and Breiwick (1984a) that very little is known of movements and stock boundaries in the North Pacific. Several authors have suggested that blue whales observed off of California are distinct from those observed in the Gulf of Alaska and the eastern Aleutians. This conclusion was reached by Rice (1992) based on the presence of certain epizootics on blue whales in California, versus those found on other whale species that migrate north. After comparison of the total lengths of blue whales off California with those south of the Aleutian Islands and in the Gulf of Alaska, Gilpatrick et al. (1996) also recognized a "California stock" and a "North Pacific" stock. This view also was supported by analysis of photo-identification data that indicated that blue whales that winter off of Baja California and in the Gulf of California travel in summer and fall to waters off California (Calambokidis et al., 1990; Barlow et al., 1997; Sears, Wenzell, and Williamson, 1987). Based on acoustic data that indicated continuity between blue whales in the Eastern Tropical Pacific and those found in the eastern North Pacific Ocean west of North America, Stafford, Nieukirk, and Fox (1999:1258) suggested that "…the population of blue whales generally referred to as the "California/Mexico stock" might better be termed the "northeast Pacific" stock…." Based on differences in acoustic signatures in the northeastern versus the northwestern Pacific, Stafford, Nieukirk, and Fox (2001) suggested there may be at least two distinct groups of blue whales in the North Pacific. "Northeastern" Pacific type of blue whale vocalizations were recorded from July-December in the northeast Pacific and from February-May in the eastern tropical Pacific (Stafford, Nieukirk, and Fox 2001).

Based on plots of the capture location and the total lengths of blue whales killed during commercial whaling in the North Pacific, Forney and Brownell (1996) concluded that the data supported the idea that blue whales in the area southeast of the Kamchatka Peninsula are from a different population (a purported "western stock") than those in the area south of the Aleutian Islands (which they refer to as a "central stock"). However, they cautioned that additional information on the population structure of North Pacific blue whales was needed before it would be possible to assess population status in the region. Gambell (1979) suggested there was a western, central, and eastern stock of blue whales in the North Pacific.

Because of the current information about stock structure, we focus our attention on information available for blue whales north of California. However, we consider information from animals that winter off California when it is helpful for explaining the probable effects of the Proposed Action on blue whales in the Gulf of Alaska.

III.B.4.b(2)(d) Current Status and Protective Legislation

The blue whale was listed as endangered under the ESA in 1973. All blue whale stocks in U.S. waters are listed as endangered (Anonymous, 1994a, cited in Perry, DeMaster, and Silber, 1999a). It is designated as "depleted" and as a "strategic stock" under the Marine Mammal Protection Act. A Recovery Plan for the Blue Whale was finalized in 1998 (National Marine Fisheries Service, 1998).

While the National Marine Fisheries Service recognizes only one stock of blue whales in the eastern North Pacific, the current stock assessment for the eastern North Pacific blue whale stock (Carretta et al., 2001:156) stated that it covers "…one population that feeds in California waters…(from June to November) and migrates south to…areas off Mexico…" and to points farther south. This stock assessment reported that "One other stock of North Pacific blue whales (in Hawaiian waters) is recognized in the Marine Mammal Protection Act…Stock Assessment Reports" (Carretta et al., 2001:156). Perry, DeMaster, and Silber (1999a) recently provided a status report for all blue whales, including information on the status of North Pacific blue whales.

The International Whaling Commission classifies all blue whale stocks as "Protected Stocks" (International Whaling Commission, 1995a). The International Whaling Commission banned commercial exploitation of blue whales in 1966 (Forney and Brownell, 1996), although Soviet whalers probably continued to catch blue whales after this period (Yablokov, 1994; see Section V.C.5.f - Cumulative Effects).

There are no published criteria for delisting (National Marine Fisheries Service, 1998), and we found no record of request for, or designation of, critical habitat for any population stock of blue whales. The blue whale is listed as "endangered" under Appendix I of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973, as amended 1979, and provisionally at Gaborone April 30, 1983, with Appendices [I and II, April 16, 1993; III, June 11, 1992]) (National Marine Fisheries Service, 1991a; Corn, 1995).

III.B.4.b(2)(e) Historic and Current Distribution Patterns

Blue whales are distributed worldwide, occurring primarily in the open ocean. They presumably undergo a seasonal migration from high latitude summer areas to lower latitude winter areas (Perry, DeMaster, and Silber, 1999a). However, migration routes are not well known (Perry, DeMaster, and Silber, 1999a), and locations of wintering areas are somewhat speculative (Jonsgård, 1966; Perry, DeMaster, and Silber, 1999a). They are found along coastal shelves of North America (Rice, 1974; Clarke, 1980; Donovan, 1984; Perry, DeMaster, and Silber, 1999a). There are no current distribution data for blue whales in the western North Pacific Ocean.

It is becoming increasingly apparent that conclusions about blue whale distribution based primarily on observational or stranding data may underestimate their range and use of specific areas. For example, detection of blue whale vocalizations in the Pacific Ocean near Midway Island and Oahu (Thompson and Friedl, 1982; Northrop, Cummings, and Morrison, 1971) indicate blue whales inhabit this area although they have not been sighted in these locations, and strandings have not been reported. With that caveat, we summarize known data on historic and current distribution and abundance data in the following paragraphs.

Blue whales historically inhabited areas in the North Pacific south of the Aleutian Islands and in the Gulf of Alaska. There is no evidence that blue whales currently inhabit waters within the proposed Cook Inlet sales area or adjacent waters of Shelikof Strait. However, there are rare sightings of blue whales in the Gulf of Alaska. Additionally, acoustical evidence from the Gulf of Alaska indicate there are blue whales in the Gulf of Alaska at least seasonally (see the following), but the abundance or habitat use of these whales is unknown. Based on reported sighting data (Map 12), they are not abundant. However, these data should not be interpreted to indicate abundance or as absolute indicators of abundance. Lack of sightings for an area does not mean the whale does not inhabit a particular range. Blue whales are not known to inhabit most areas north of the Aleutian Islands except rarely in the far southwestern Bering Sea (Rice, 1998).

The south side of the Aleutian Islands, especially between approximately 165°-172° W. longitude, was the region of the largest harvests of blue whales (Nishiwaki, 1966; Forney and Brownell, 1996) during Japanese pelagic whaling expeditions in the North Pacific from 1952-1965 (Ohsumi and Wada, 1972). Forney and Brownell (1996) provide the following summary of the recorded (presumably the retrieved) take of blue whales in the North Pacific (presumably from all sources) in this period: between 1952 and 1961, an average of 80 blue whales per year; 67 in 1962; 404 in 1963; 119 in 1964; and 121 in 1965 (the last year of legal blue whale harvest). Few blue whales were observed during Japanese whale sighting surveys between 1966 and 1978, with an approximate average (Forney and Brownell, 1996) of one blue whale per 4,400 kilometers (2,734 miles) surveyed (see data in Wada, 1979, 1980). No blue whales were observed during a ship survey conducted between mid June and late August 1980 in the Gulf of Alaska from Cape Fairweather to Chirikof Island, and also including Shelikof Strait, Yakutat, and Icy Bays, Prince William Sound, and coastal waters from Chirikof to Dutch Harbor (Rice and Wolman, 1982). No blue whales were observed during the most recent (1994) ship survey in which a zig-zag pattern was followed extending about 370 kilometers (200 nautical miles) southward between Tanaga Island in the Aleutians and the south end of the Kodiak Archipelago (Forney and Brownell, 1996:6). The authors summarized the lack of blue whales as "…the most notable negative observation from our survey." Perry, DeMaster, and Silber (1999a) reported that, as of 1987, there have not been blue whale sightings in the Gulf of Alaska or the Aleutians. However, the Platforms of Opportunity Database contains one blue whale sighting in 1995 in the Gulf of Alaska south of Kodiak Island.

Despite the extreme rarity of recent sightings of blue whales in the Gulf of Alaska over the past 15 years, blue whale vocalization data collected over the past 2 years using passive acoustic recorders consistently indicate that blue whales are present in the Gulf of Alaska region between July and December (Stafford, 2002. pers. commun.). Based on analyses of the data to date, it is not clear how many individuals are present. The maximum number confirmed to be vocalizing at one time is three individuals (Stafford, 2002, pers. commun.). The locations of the whales cannot be localized from the recordings. The recorders probably can detect vocalizations within 100 or more kilometers (Stafford, 2002, pers. commun.).

There are no data indicating the migration patterns or wintering areas of blue whales that inhabit the Gulf of Alaska in the summer.

III.B.4.b(2)(f) Historic and Current Abundance and Current Population Status

Commercial exploitation of blue whales began around 1864 (Perry, DeMaster, and Silber, 1999a). This hunting led to a cyclic rise and fall in abundance and eventually to the severe depletion of blue whale stocks worldwide (Mizroch, Rice, and Breiwick, 1984a). It is not possible, however, to quantitatively compare historic and current numbers of blue whales in the North Pacific because historic estimates are speculative, (see the following), and there are no current reliable estimates of abundance for most of the North Pacific.

Estimates of abundance of blue whales in the North Pacific prior to commercial exploitation are "rather speculative" (Perry, DeMaster, and Silber, 1999a:40). However, based on whaling data (Gambell, 1976) an estimated 4,900 (no coefficient of variation available) (Perry, DeMaster, and Silber, 1999a) blue whales inhabited the North Pacific before commercial whaling began. Approximately 5,761 blue whales were harvested in the North Pacific between 1889 and 1965 (Braham, 1991). Evidence of a population decline is detectable in Japanese catch data (Mizroch, Rice, and Breiwick, 1984a; Perry, DeMaster, and Silber, 1999a).

Perry, DeMaster, and Silber (1999a:40) reported that there are "…no statistically reliable population estimates for the eastern North Pacific north of…Washington or in the western North Pacific. Nonetheless, it appears that at a minimum, there are currently over 3,300 blue whales in the North Pacific (Wade and Gerrodette, 1993; Barlow, 1997)…" (Perry, DeMaster, and Silber, 1999a).

It is apparent that evaluation of the current population status of blue whales in the eastern North Pacific (and elsewhere) await more reliable information on stock structure, migration patterns and distances, abundance trends, sources of mortality, and factors influencing recovery, as well as the definition of objective delisting criteria (Perry, DeMaster, and Silber, 1999a).

III.B.4.b(2)(g) Foraging Ecology and Feeding Areas of Blue Whales in the North Pacific

The distribution of blue whales is probably linked to their nutritional requirements and to prey aggregations that may, depending on the prey species and the area, be seasonal, year round, or influenced by El Niño events (see Perry, DeMaster, and Silber, 1999a and references cited therein).

In the North Pacific, blue whales eat primarily euphausiids and other krill, including *E. pacifica*, *Thysanoessa inermis*, *T. longipes*, and *T. spinifera* (Schoenherr, 1991). Other krill species have been reported from other regions (see Perry, DeMaster, and Silber, 1999a for a complete review). Blue whales also are known to consume copepods (Kawamura, 1980; Nemoto, 1970; (Thompson, 1940; Tomilin, 1967) and less frequently, squid and amphipods (Mizue, 1951; Perry, DeMaster, and Silber, 1999a). Off the Pacific coast of Baja California, blue whales feed on the pelagic crab *Pleuroncodes planipes* (Rice, 1978a).

III.B.4.b(2)(h) Mortality

Causes and rates of natural mortality of blue whales are unknown (Perry, DeMaster, and Silber, 1999a). The National Marine Fisheries Service (1998) concluded that potential indirect threats to blue whales include vessel collisions, entanglement in fishing gear, low frequency noise disturbance and reduction in prey species (for example, *Euphausiids*) due to habitat degradation.

Know human-related mortality also is discussed in Section V.C.5.f.

III.B.4.b(2)(i) Reproductive Biology

Calving areas for blue whales that seasonally occur in the Gulf of Alaska are unknown. Both male and female blue whales reach sexual maturity at about 5-15 years of age. Females give birth to a single calf. Gestation is approximately 12 months (Mizroch, Rice, and Breiwick, 1984a; Perry, DeMaster, and Silber, 1999a). Current information about reproductive intervals is unavailable. Based primarily on pre-1967 data, dependency periods are about 7 months (Mizroch, Rice, and Breiwick, 1984a). However, the extent to which any of these reproductive parameters has changed due to changes in population size, prey base, or other factors is unknown.

III.B.4.b(3) Humpback Whale (*Megaptera novaeangliae*) (Central and Western North Pacific Stocks) – Endangered

III.B.4.b(3)(a) Summary

In the summer, humpback whales regularly are present and feeding in areas near and within the proposed Cook Inlet sales area, including Shelikof Strait, bays of Kodiak Island, and the Barren Islands, in addition to the Gulf of Alaska adjacent to the southeast side of Kodiak Island (especially Albatross Banks), the south sides of the Kenai and Alaska Peninsulas, and south of the Aleutian Islands (Map 11). There is some evidence for a discrete feeding aggregation of humpbacks in the Kodiak Island region. Humpbacks also may be present in some of these areas throughout the autumn. Within the proposed lease sale area, large numbers of humpbacks have been observed in late spring and early summer feeding near the Barren Islands. Humpbacks have also been observed feeding near the Kenai Peninsula north and east of Elizabeth Island.

III.B.4.b(3)(b) General Description

The humpback whale is a medium-sized baleen whale. At maturity, they reach a length of about 15 meters (~49 feet) and weigh about 34 metric tons (~74,957 pounds). Humpbacks are easily identified by their long, wing-like pectoral flippers, tubercles covering their heads, and individually identifiable tail flukes (Perry, DeMaster, and Silber, 1999b).

III.B.4.b(3)(c) Current Status and Protective Legislation

The International Whaling Commission banned commercial hunting of humpbacks in the Pacific Ocean in 1965 (Perry, DeMaster, and Silber, 1999b). In 1973, humpback whales were listed as endangered under the ESA and as depleted under the Marine Mammal Protection Act. All stocks in U.S. waters are considered endangered (Perry, DeMaster, and Silber, 1999b, citing U.S. Dept. of Commerce, 1994b). All stocks of humpbacks are classified as “Protected Stocks” by the International Whaling Commission (International Whaling Commission, 1995b). The National Marine Fisheries Service published a Final Recovery Plan for the Humpback whale in November, 1991 (National Marine Fisheries Service, 1991b).

On May 3, 2001, the National Marine Fisheries Service (66 *FR* 29502) published a final rule that established regulations applicable within waters within 200 nautical miles of Alaska that made it unlawful for a person subject to the jurisdiction of the U.S. to approach, by any means, within 100 yards (91.4 meters) of a humpback whale. The National Marine Fishery Service also implemented a “slow, safe speed” requirement for vessels transiting near humpbacks. Exemptions to the rule were for commercial-fishing vessels during the course of fishing operations, for vessels with limited maneuverability, and for State, local, and Federal vessels operating in the course of official duty. This law was enacted to prevent disturbance that could adversely affect humpbacks and to reduce threats from whale watching activities.

III.B.4.b(3)(d) Current Stock Definitions, Population Structure, and Distribution

There is “no clear consensus” (Calambokidis et al., 1997:6) about the population stock structure of humpback whales in the North Pacific due to insufficient information (Angliss and Lodge, 2002). There may be separate stocks of humpback in the North Pacific (Perry, DeMaster, and Silber, 1999b). For management purposes, the International Whaling Commission lumps all humpback whales in the North Pacific Ocean into one stock (Donovan, 1991). In the North Pacific, the National Marine Fisheries Service recognizes three “management units” within the U.S. Exclusive Economic Zone: an Eastern North Pacific unit (California/Oregon/Washington/Mexico); a central North Pacific unit; and a western North Pacific Unit. Based on this breakdown, two “management units” of humpbacks (also referred to as stocks in titles of stock assessments) reasonably could be expected to occur seasonally with differing frequencies in areas near the Cook Inlet Sales 191 and 199 area (see the following). To ensure compatibility with titles of the National Marine Fisheries Service annual stock assessments, we refer to these groups in the remainder of the document as the Western North Pacific Stock and the Central North Pacific Stock. Where appropriate, we will specify information that is specific to only one of these two groups.

Humpback whales range throughout the world’s oceans, with lower frequency use of Arctic waters (Perry, DeMaster, and Silber, 1999b; Angliss and Lodge, 2002). Knowledge of their movements and the interrelations of individuals seen on different summer feeding grounds and those on different winter calving/breeding grounds is based on the recovery of whaling records about harvest locations, Discovery tags used in commercial-whaling operations, photo-identification, genetic analyses, and comparison of songs (Perry, DeMaster, and Silber, 1999b). In the North Pacific each year, most (but not all individuals in all years) humpbacks undergo a seasonal migration from wintering habitats in tropical and temperate regions (10°-23° N. latitude), where they calve and mate, to more northern regions, where they feed on zooplankton and small schooling fish species in coastal and inland waters from Pt. Conception, California to the Gulf of Alaska and then west along the Aleutian Islands, the Bering Sea, the Kamchatka Peninsula and to the southeast into the Sea of Okhotsk (Angliss and Lodge, 2002; Nemoto, 1957). Johnson and Wolman (1984) report that humpbacks have been reported in the Chukchi Sea.

Due to evidence that there is some intermixing among wintering areas, some researchers suggest that there is only one, or at most two, stocks (for example, Darling et al., 1996). Based on differences in mitochondrial DNA, Baker et al. (1994) concluded that humpbacks in the eastern North Pacific could be divided into two or more stocks, one of which feeds in Alaska waters and generally migrates to Hawaii and an "American" stock that summers along California and winters off Mexico. Genetic differences between California and Alaska feeding groups have been detected based on analyses of mitochondrial DNA and nuclear DNA (Baker et al., 1990; 1994). Based on available resighting data, whaling records, and available genetic analysis, and based on the need to be conservative in the defining of populations, Barlow (1994) concluded that four populations of humpbacks should be recognized. Listed by summer and winter areas, these would be:

1. Mexico/Costa Rica and California/Oregon/Washington;
2. offshore Mexico-Isla Revillagigigedo and unknown summer area;
3. central North Pacific-Hawaii and Alaska; Prince William Sound to British Columbia; and
4. western North Pacific-Japan, Taiwan, and a Bering Sea/Aleutian Island stock of animals west of Kodiak.

Most recently, the National Marine Fisheries Service (Angliss and Lodge, 2002) concluded that, based on aerial, vessel and photo-identification surveys, as well as genetic analyses, there may be at least three relatively separate populations within the U.S. Exclusive Economic Zone that move seasonally between winter/spring calving and mating ares and summer/fall feeding areas:

1. a California/Oregon/Washington and Mexico stock;
2. a Central North Pacific stock, which spends the winter/spring in the Hawaiian Islands and migrates seasonally to northern British Columbia, Southeast Alaska, Prince William Sound, and west to Kodiak; and
3. a western North Pacific Stock, which spends the winter/spring in Japan and migrates to spend summer and fall to areas west of the Kodiak Archipelago.

Based on the comparison of photographs of at least 2,712 individual humpback whales taken between 1991 and 1993 (and including 1990 for Mexico), Calambokidis et al. (1997) were able to evaluate rates of interchange among individuals from three wintering areas (Mexico, Hawaii, and Japan) and feeding areas extending from California to the Aleutian Islands. Over the years studied, individual whales tended to return to specific feeding locations. Interchange among feeding areas was only observed for four whales with the interchanges being between the following areas: one Kodiak and Prince William Sound, one Kodiak and Southeast Alaska, and two Prince William Sound and Southeast Alaska. Thus, movements among feeding areas seem to be relatively uncommon. However, the authors caution that defining the feeding areas is difficult because of limited sampling and nearly continuous distribution of whales.

Evidence indicates that the Kodiak Island/Shelikof Strait area is an important feeding area for humpback whales, and that there may be discrete feeding aggregations of humpback whales in this area. Waite documented 127 individuals in the area between 1991 and 1994. Only 7 of 164 individuals identified during a recent 3-year photo-identification study from areas near Kodiak (127), the Shumagins (22), southeast of the Shumagins (8), and near Akutan Island (7) have been observed in Prince William Sound or southeast Alaska (Waite et al., 1999). Four of 127 Kodiak whales and 1 of 8 whales observed offshore also were seen in Prince William Sound. Two of 127 whales observed in Kodiak were observed in Southeast Alaska. No other matches were seen. None of the whales observed in Kodiak were observed also in California (Calambokidis et al., 1997). Evidence from this study suggests that there may be a discrete (Angliss and Lodge, 2002) feeding aggregation of humpback in the Kodiak region. Based on aerial (1985) and vessel (1987) surveys, Brueggeman et al. (1989) suggested that there are discrete groups of humpbacks in the Shumagins, but data are insufficient to characterize numbers or structure of humpbacks in this area (Waite et al., 1999).

Available data (Sease and Fadely, 2001) also indicate that the area near the Barrren Islands is an important feeding area for humpback whales. In the course of undertaking research on Steller sea lions in May of 2001, Sease and Fdely (2001) observed hundreds of humpbacks feeding near the Barren Islands and humpbacks have been observed feeding in this area in other years. There are no current estimates of the number of humpbacks that typically feed in this area. The typical intensity of use of this area by humpbacks at different times throughout the late spring through the autumn period is not known. In comments on the draft EIS, the National Marine Fisheries Service reported that humpbacks have also been observed feeding near the Kenai Peninsula north and east of Elizabeth Island.

The relationship among feeding aggregations and population stock units is complicated and unclear. Low rates of interchange were detected among the three main wintering units (there was interchange among smaller subdivisions of wintering areas, such as in Hawaii). Whales that wintered at the three main wintering areas migrated to them from multiple feeding areas but whales from some feeding areas, such as Southeast Alaska, showed a tendency to go to particular wintering grounds (in that case to Hawaii). However, whales that were observed feeding, in the years studied, at other locations tended to travel to multiple winter areas (for example, whales that summered off of British Columbia wintered at all three main areas about equally) (Calambokidis et al., 1997).

Photo-identification data indicate that the vast majority of the whales that feed in the Gulf of Alaska region migrate to the Hawaiian Islands for the winter. Only three individuals were observed to travel to Mexico, and one traveled to the Bonin Islands area south of Japan (Calambokidis et al., 1997). It is unclear what location(s) humpback whales that summer in the Kodiak region typically go to in the winter to calve and to breed. Most of the humpback whales that winter in Japan have been observed in the summer feeding in the eastern North Pacific (in the feeding range of the purported Central North Pacific stock) but have not been observed in the Bering Sea and/or the Aleutian Islands, areas considered to be the historical feeding areas of the stock. However, this lack of sightings may be due to a lack of effort in identifying humpback whales west of Kodiak (Angliss and Lodge, 2002).

Humpbacks that calve and breed off Japan have been resighted in the Bering Sea, Aleutian Islands, off British Columbia, and in the Hawaiian Islands area. The typical feeding areas of these whales are still uncertain (Perry, DeMaster, and Silber, 1999b).

In late 2001, the Alaska Scientific Review Group questioned the eastern Pacific/western Pacific distinction, stating that there "is a 'clear break'" in "distribution" of feeding aggregations of humpbacks "between southeast Alaska and Prince William Sound, but no clear 'break'" between Prince William Sound and waters to the west (Alaska Scientific Review Group, 2001).

During a 1994 ship survey in which a zig-zag pattern was followed extending about 200 nautical miles (370 kilometers) southward between Tanaga Island in the Aleutians and the south end of the Kodiak Archipelago, Forney and Brownell (1996) observed humpback whales throughout the study area, especially in the eastern half, nearer to Kodiak Island and south of the Alaska Peninsula between 152° and 165° W. longitude. In this region, humpbacks were observed in "…scattered aggregations extending many miles" (Forney and Brownell (1996:4) usually offshore in deep water over the Aleutian Trench or Aleutian Abyssal Plain. Humpbacks also were observed scattered throughout the western region surveyed between 167° and 175° W. longitude. It is not known which stock of whales the humpbacks observed during this survey belonged to (Angliss and Lodge, 2002).

Results of ship surveys in the Bering Sea in July of 1999 indicate that the Bering Sea is an important feeding area for humpbacks (Moore et al., cited in Angliss and Lodge, 2002).

Acoustic monitoring from May 26-September 11, 2000 of the area south of Kodiak Island detected a large number of humpback whale calls (Waite, Wynne, and Mellinger, In press).

III.B.4.b(3)(e) Historic and Current Abundance in the North Pacific and in the Areas Near the Proposed Lease-Sale Area

The reliability of pre- and postexploitation and of current abundance estimates is uncertain. No estimate of the current total number of humpback whales in the North Pacific has been recognized as accurate by the International Whaling Commission (1995b). Data on current population trends are inconclusive for the North Pacific stocks (Perry, DeMaster, and Silber, 1999b). The potential biological removal is unknown for both stocks. Based on whaling records (Perry, DeMaster, and Silber, 1999b), Rice (1978b) estimated there were about 15,000 humpbacks in the North Pacific prior to commercial exploitation. It is known that Soviet whalers under-reported their takes of certain species of whales in the North Pacific (Yablokov, 1994). Johnson and Wolman (1984) and Rice (1978a) made reported rough estimates of 1,200, and 1,000, respectively, of the numbers of humpbacks surviving in the North Pacific after the cessation of commercial whaling for humpbacks in 1966, but Perry, DeMaster, and Silber (1999b) caution that it is unclear whether these estimates are for the entire North Pacific or only the eastern North Pacific. With respect to the estimate of Johnson and Wohlman and another postexploitation estimate of 1,400 by Gambell (1976), Calambokidis et al. (1997) concluded that "…the methods used for these estimates are uncertain and their reliability questionable."

Using various capture-recapture models, Calambokidis et al. (1997) estimated the abundance of humpback whales at the three studied wintering areas to be as follows: 4,000-5,200 for Hawaii, 1,600-4,200 for Mexico, and 400 for Japan. They suggested that the large disparity in estimates for Mexico may result from sampling and stratification problems and suggested also that the true abundance for Mexico may lie between the two estimates. Based on the estimates for the three wintering areas, Calambokidis et al. (1997) reported that their best estimate for humpbacks in the North Pacific was 6,010 (SE ± 474). Adjusting for the effects of sex bias in their sampling and use of the higher estimate for Mexico yielded an estimate of about 8,000 humpback whales in the North Pacific. Perry, DeMaster, and Silber (1999b) concluded that Calambokidis et al.'s (1997) estimate of about 6,000 probably was too low.

Based on capture-recapture models applied to photo-identification data, the most recent estimates for the current population size of the western North Pacific stock and the central North Pacific stock are 394 (CV = 0.084) and 4,005 (CV = 0.095) (Calambokidis et al., 1997).

III.B.4.b(3)(f) Feeding

Several features characterize the feeding of humpbacks. First, they tend to feed on summer grounds and to not eat on winter grounds. However, some low-latitude winter feeding has been observed and is considered opportunistic (Perry, DeMaster, and Silber, 1999b). Humpbacks engulf large volumes of water and then filter small crustaceans and fish through the fringed baleen plates they have rather than teeth. They are relatively generalized in their feeding compared to some other rorquals (for example, compared to right whales). In the Northern Hemisphere, known prey includes: euphausiids (krill); copepods; juvenile salmonids, *Oncorhynchus* spp.; Arctic cod, *Boreogadus saida*; walleye pollock, *Theragra chalcogramma*; pollock, *Pollachius virens*; pteropods; and cephalopods (Johnson and Wolman, 1984; Perry, DeMaster, and Silber, 1999b). Bottom feeding recently has been documented in humpbacks off the east coast of North America (Swingle, Barco, and Pichford, 1993). Within a feeding area, individuals may use a large part of the area. Two individual humpbacks sighted in the Kodiak area were observed to move 68 kilometers (~42.25 miles) in 6 days and 10 kilometers (~6.2 miles) in 1 day, respectively (Waite et al., 1999).

As previously noted, areas within the proposed sale area near the Barren Islands and areas in the Gulf of Alaska adjacent to the Kodiak Archipelago, are used consistently by large numbers of humpbacks for feeding. In comments on the Cook Inlet draft EIS, the USDOC, National Oceanic and Atmospheric Administration (2003:4) stated that

> it is also evident the sale area support feeding aggregations of humpback whales from one or more stocks. NMFS has received many reports of 'several hundred' humpbacks sighted near the Barren Islands by summer fishing charters, and have observed humpbacks on several occasions feeding near the Kenai Peninsula coastline north and east of Elizabeth Island.

Sease and Fadely (2001) observed "hundreds" of humpbacks near the Barren Islands during a research Cruise in late May 2001.

III.B.4.b(3)(g) Reproduction

Perry, DeMaster, and Silber (1999b) summarized that calving occurs along continental shelves in shallow coastal waters and off some oceanic islands (for example, Hawaii). Calving in the Northern Hemisphere takes place between January and March (Johnson and Wolman, 1984). Information about age of sexual maturity is of uncertain reliability (Perry, DeMaster, and Silber, 1999b). Gestation is about 12 months, and calves probably are weaned after about a year (Rice, 1967; Perry, DeMaster, and Silber, 1999b).

III.B.4.b(3)(h) Rates and Sources of Mortality and Other Factors Potentially Influencing Recovery

As with many of the other baleen whale species, humpback whales were depleted by intensive commercial whaling beginning in 1889 in the western Pacific and in 1905 in the eastern Pacific. Records indicate 23,000 humpbacks were taken between 1905 and 1960 (Johnson and Wolman, 1984) and more than 5,000 between 1960 and 1965 (Rice, 1978b). Soviet whaling continued until 1980 (Zemsky et al., 1995).

Causes of natural mortality in humpbacks in the North Pacific are relatively unknown, and rates have not been estimated. There are documented attacks by killer whales on humpbacks, but their known frequency is low (Whitehead, 1987; Perry, DeMaster, and Silber, 1999b). Lambertsen (1992) cited giant nematode infestation as a potential factor limiting humpback recovery

Based on sighting histories of individually identified female humpback in the North Pacific compiled between 1979 and 1995, Gabriele et al. (2001) calculated minimal and maximal estimates of humpback whale calves in the North Pacific of 0.150 (95% confidence intervals = 0.032, 0.378) and 0.0.241 (95% confidence intervals = 0.103, 0.434), respectively.

III.B.4.b(3)(i) Human-Related Conservation Concerns

Based on the general category of factors specified as requiring consideration under the ESA, Perry, DeMaster, and Silber (1999b) listed the following factors as possibly impacting the recovery of humpbacks in the North Pacific:

1. vessel traffic and oil and gas exploration as types of “Present or threatened destruction or modification of habitat”(Central Stock);
2. whale watching, scientific research, photography, and associated vessel traffic as types of “Overutilization…” (Central Stock); and
3. entanglement in fishing gear as “Other natural or man-made factors” (Central Stock).

They list the threat of disease or predation as unknown.

During 1990-2000, six commercial fisheries within the range of the both the western and central North Pacific stocks were monitored: Bering Sea/Aleutian Island and Gulf of Alaska groundfish trawl, longline, and pot fisheries. One humpback was killed in the Bering Sea/Aleutian Island groundfish trawl fishery in 1998 and one in 1999. There are no records of humpbacks killed or injured in the fisheries in which fishers self report (Angliss and Lodge, 2002), but the reliability of such data is unknown. One entanglement is recorded in 1997 for a humpback in the Bering Strait (Angliss and Lodge, 2002). However, between 1996 and 2000, five entanglements of humpbacks from the Central North Pacific Stock were reported in Hawaiian waters. In Alaska, 20 humpbacks from this stock were reported entangled in fishing gear (gear types including crab pot, purse seine, shrimp pot, gillnet) and 2 were reported as struck by vessels. The Alaska Scientific Review Group (2001) stated that 32 humpbacks were entangled in southeast Alaska in the past 5 years. Vessel strikes cause significant mortality in humpbacks in the California/Oregon/Washington stock (an average of 0.6 killed per year) (Barlow et al., 1997) and in the western Atlantic (Perry, DeMaster, and Silber, 1999b). Perry, DeMaster, and Silber (1999b) reported that continued development of coasts and oil exploitation and drilling may lead to humpbacks avoidance of areas. In a Newfoundland inlet, two humpbacks with severe mechanical damage to their ears were found dead near a site of continued subbottom blasting (Ketten, Lien, and Todd, 1993; Lien et al., 1993; Ketten, 1995). Perry, DeMaster, and Silber (1999b) summarized that humpbacks respond the most to moving sound sources (for example, fishing vessels, low-flying aircraft). Long-term displacement of humpbacks from Glacier Bay and parts of Hawaii may have occurred due to vessel-noise disturbance (see references in Perry, DeMaster, and Silber, 1999b) (see further discussion in Section IV.B.1.f). Noise on their wintering grounds from the ATOC and the Navy’s Low-Frequency Active Sonar program also are sources of concern for the central North Pacific stock (Angliss and Lodge, 2002). No subsistence take of humpbacks is reported from Alaska or Russia (Angliss and Lodge, 2002).

Perry, DeMaster and Silber (1999b:35) concluded that, based on available information, "commercial fishing activities may pose a significant threat to the status…" of the stock of humpbacks inhabiting the western North Atlantic. Todd et al. (1996) have suggested that exposure to deleterious levels of sound may be related to rates of entrapment in fishing gear. Rates of entrapment between 1980 and 1992 were shown to vary between a low of 26 per year to a high of 200 (see Todd et al., 1996:Table 1 and references cited therein). Coinciding with development-related noise (drilling and explosions) in one bay, rates of entrapment rose. Todd et al. (1996) concluded that exposure of the humpbacks to deleterious levels of sound may have influenced entrapment rates.

III.B.4.b(4) North Pacific Right Whale (*Eubalaena japonica; also referred to as E. glacialis)* Eastern North Pacific Stock – Endangered

III.B.4.b(4)(a) Summary

The North Pacific right whale (also referred to historically as *Balaena glacialis*), recently recognized by the International Whaling Commission (2001a) and the National Marine Fisheries Service (Angliss and Lodge, 2002; 68 *FR* 17560) as a distinct species from the North Atlantic right whale (which retains the scientific name of *Eubalaena glacialis*), is one of the most critically endangered species of large whale (International Whaling Commission, 2001; Brownell et al., 2001). The Northeast stock of North Pacific right whales may be the world's most depleted population of large whale (National Marine Fisheries Service, 1991; Tynan, 1999). The Gulf of Alaska, including areas adjacent to the Kenai Peninsula and the Kodiak Archipelago, was historically an area of high abundance for right whales during the summer (for example, Maury, 1852; Rice, 1974; Scarff, 1986; Webb, 1988). Because of the current extreme rarity of this species, and of this population stock in particular, it has been observed only rarely, but occasionally, in this area in the last few decades (see Brownell et al., 2001 and information summarized in the following).

Because of its rarity, definitive information about many basic aspects of the status and ecology of North Pacific right whales remains unknown. Thus, we provide available information about other delineated stocks and/or species of right whale when it is relevant to understanding the potential effects of the Proposed Action on the Northeast Stock of North Pacific right whales. However, previously unavailable information, new analyses, and some new information are now available. For details on North Pacific right whale history, ecology, taxonomy, conservation concerns, and other issues that are beyond the scope of this document, we refer the reader to the *Journal of Cetacean Research* Special Issue 2 (International Whaling Commission, 2001) and papers contained therein; *Alaska Marine Mammal Stock Assessments, 2002* (Angliss and Lodge, 2002); International Whaling Commission Report Series Special Issue 10; Perry, DeMaster, and Silber (1999c); the Recovery Plan for the Northern Right Whale (National Marine Fisheries Service, 1991b), and to other references cited here and in the aforementioned reviews.

III.B.4.b(4)(b) Basic Description

The North Pacific right whale is a medium-sized, baleen whale. Adults can weigh up to 70 tons and typically range between 45-55 feet (~13.7-16.8 meters) in length, with females generally attaining larger size than males (National Marine Fisheries Service, 1991b). While it resembles the bowhead whale (*Balaena mysticetus*), having a robust build; lacking a dorsal fin; and having a narrow, arched rostrum; it is identifiable by callosities on its rostrum and by scalloped lower lips (Braham and Rice, 1984).

III.B.4.b(4)(c) Current Species and Population Stock Designations

Species-level nomenclature and distinctions of right whales have varied (for example, Lacépéde, 1818 cited in Rosenbaum et al., 2000; Rice, 1998; Rosenbaum et al., 2000). North Pacific right whales are apparently geographically isolated from (for example, Maury, 1852) and are a distinct species from right whales in the Southern Hemisphere. Based on information on mitochondrial sequence variability from current and historical samples from the western North Atlantic, the western and eastern North Pacific, and from the southern hemisphere, Rosenbaum et al. (2000) suggested there may be three distinct maternal lineages in right whales, with the North Pacific right whales being more similar to right whales in the southern hemisphere than to those in the Atlantic. They concluded that there is unequivocal character support for continued species-level distinction of Northern and Southern Hemisphere right whales and for the existence of a distinct genetic lineage in the North Pacific. Based on these findings, right whales in the North Pacific and North Atlantic are now recognized by the International Whaling Commission (2001a) and by the National Marine Fisheries Service as distinct species *Eubalaena japonica* and *Eubalaena glacialis,* respectively (Angliss and Lodge, 2002).

There is a high degree of uncertainty about stock structure in the North Pacific right whale due to limited information (Brownell et al., 2001; Angliss and Lodge, 2002) and almost no knowledge of migration patterns, calving areas, etc. (see the following). Two stocks of North Pacific right whales currently are recognized by Angliss and Lodge (2002) due to apparently distinct geographic distributions: an eastern North Pacific Stock and a Sea of Okhotsk Stock (Rosenbaum et al., 2000). However, Brownell et al. (2001:270) stated: "There is no agreement on the number of populations that exist…."

III.B.4.b(4)(d) Current Management and Protective Status

The North Pacific right whale (under various nomenclatures) has been legally protected from commercial whaling by provisions of the implementing convention of the International Whaling Commission since 1949 (National Marine Fisheries Service, 1991b) (but see the following and details in Brownell et al., 2001] regarding illegal whaling of right whales). The Northern right whale (including both North Pacific and North Atlantic right whales) was listed as endangered under the Endangered Species Conservation Act (precursor to the ESA) in 1970 , subsequently listed under the ESA in 1973 as endangered, and listed as "depleted" under the Marine Mammal Protection Act in 1973. Under 1994 amendments to the Marine Mammal Protection Act, it also is now classified as a "strategic stock." The National Marine Fisheries Service (1991b) finalized a Recovery Plan for the Northern Right Whale in December 1991. However, citing the scarcity of sightings of right whales in the North Pacific and the related extreme lack of information about factors affecting its population status, the recovery plan focused on research and management recommendations for right whales in the western North Atlantic.

On October 4, 2000, the National Marine Fisheries Service received a petition from the Center for Biological Diversity to designate critical habitat for the North Pacific right whale in the southeast Bering Sea shelf from 55° to 60° N latitude. The National Marine Fisheries Service found the petition to have merit (66 *FR* 29773) warranting consideration; however, on February 20, 2002, the National Marine Fisheries Service published a final determination that "…the revision of critical habitat may be prudent, but…that the extent of critical habitat cannot be determined at this time…" (67 *FR* 7660). No critical habitat for this species (North Pacific right whale) currently is designated. Critical habitat is designated for North Atlantic right whales. No critical habitat has been proposed for any area outside of the Bering Sea. Right whales in the North Pacific are listed as "endangered" under Appendix I of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973, as amended 1979, and provisionally at Gaborone April 30, 1983, with Appendices [I and II, April 16, 1993; III, June 11, 1992]) (National Marine Fisheries Service, 1991a; Corn, 1995). The World Conservation Union (IUCN) lists all right whale populations as endangered or vulnerable (Reeves and Leatherwood, 1994).

Because of the acceptance by the International Whaling Commission (2001a) and Angliss and Lodge (2002) of recommendations by Rosenbaum et al. (2000) for separate species status for North Atlantic and North Pacific right whales, in April of 2003, the National Marine Fisheries Service published a Notice of Technical Revision to Right Whale Nomenclature and Taxonomy Under the U.S. ESA (68 *FR* 17560) that formally recognized these distinctions. Also because of the accepted differentiation of North Pacific versus North Atlantic right whales as separate species, on July 11, 2001, the National Marine Fisheries Service published (66 *FR* 36260) a Draft Recovery Plan focused only on North Atlantic right whales (National Marine Fisheries Service, 2001a). The comment period on this document was extended (66 *FR* 44115) to October 25, 2001. According to the Western North Atlantic Right Whale Draft Recovery Plan (National Marine Fisheries Service, 2001a) and comments in the Final Determination on the petition to designated critical habitat (67 *FR* 7661), the National Marine Fisheries Service will prepare a separate recovery plan for the North Pacific right whale. The National Marine Fisheries Service has stated that a draft plan is expected to be available for public review and comment in 2002 (67 *FR* 7662).

III.B.4.b(4)(e) Historic and Current Distribution and Abundance

There is little detailed information available about basic characteristics of the distribution and abundance of North Pacific right whales. However, the relative extreme depletion, and current rarity, of this species, and especially of this stock, is not in doubt. The extent of the historic range that currently is occupied is unknown because, with population size so reduced, the probability of sighting remaining individuals, particularly alone or in small groups, is very low.

In the updated Recovery Plan for the Western North Atlantic Right Whale, Silber and Clapham (2001) summarized that right whales are generally found in coastal or continental shelf waters, but have been observed over abyssal depths (Scarff, 1986; Mate, Nieukirk, and Kraus, 1997; Perry, DeMaster, and Silber, 1999c). Their distribution is thought to be strongly correlated to their prey. They may be nomadic in summer, moving with prey (Perry, DeMaster, and Silber, 1999c).

Sightings and catch records from legal and illegal whaling provide information about especially the nonwinter range and abundance of North Pacific right whales in many parts of the eastern North Pacific, prior to exploitation in the 19th Century, and as late as the 1960's (when records from illegal whaling document locations and take from remnant populations). Such information documents that right whales were once abundant in much of the North Pacific above 35° N. latitude, occasionally ranging south as far as 20° N. latitude. In the eastern Pacific, sightings as far south as Baja California have been recorded (National Marine Fisheries Service, 1991a) and in the Yellow Sea in the western Pacific (Perry, DeMaster, and Silber, 1999c).

Historic areas of summer concentration included the Northwest or "Kodiak" Grounds in the Gulf of Alaska (see Maury, 1851, reproduced in Scarff, 1986 as Figure 1; Rice, 1974), the eastern Aleutians, southeastern Bering Sea, Sea of Japan, and Sea of Okhutsk (67 *FR* 76600; Brownell et al., 2001), the Kurils and Kamchatka. It is clear that, prior to legal and illegal whaling, the Gulf of Alaska was important summer habitat for right whales (for example, Maury, 1852; Rice, 1974; Braham and Rice, 1984; Scarff, 1986, 1991; Waite, Wynne, and Mellinger, In press). The "Kodiak" whaling ground" (defined by Rice, 1974 as Vancouver Island, Gulf of Alaska and eastern Aleutian Islands) was a favored whaling area for right whales in summer months (for example, supported by information in Brownell et al., 2001; Maury, 1852; Rice, 1974, Scammon, 1869; Scarff, 1986). The National Marine Fisheries Service (1991a) summarized that right whales were especially abundant in the Gulf of Alaska from 145°-151° W. longitude and cite Berzin and Rovnin (1966). Based on records from 1,665 voyages of some 744 vessels made between 1785 and 1916, Townsend (1935) concluded that in the North Pacific and Bering Sea, whaling was almost exclusively conducted in the summer (supporting other references indicating that the whales left the area). However, weather conditions in the Gulf of Alaska also probably influenced whaling schedules. He provided seasonal maps of catch records near Kodiak Island and the Gulf of Alaska. Right whales were more widely dispersed in fall and spring in midocean from the Sea of Japan to the eastern Bering Sea.

While it is known that North Pacific right whales occur in high latitude waters in the summer (Perry, DeMaster, and Silber, 1999c), their wintering habits are not clear. Their migration patterns are unknown (for example, Braham and Rice, 1984; Perry, DeMaster, and Silber, 1999c). It often is presumed (National Marine Fisheries Service, 1991a), but it has not been documented, that North Pacific right whales migrate to more temperate waters in the winter. Right whales have been observed along portions of the western Pacific coast in winter (National Marine Fisheries Service, 1991a) but not in high abundance. Historic whaling records do not provide evidence of wintering areas along the western coast of North America (National Marine Fisheries Service, 1991a). Scarff (1986) concluded that right whales that summered in the Gulf of Alaska may have joined Kamchatka summer-ground whales and wintered in the western North Pacific. He summarized that there was very little whaling effort in the eastern North Pacific during January through March. Only 10 sightings of right whales were recorded in the eastern North Pacific south of 50° N. latitude (Rice and Fiscus, 1968) between 1937 (when afforded complete protection by the International Whaling Commission) and 1967. Based on examination of historic data, Rowntree et al. (1980) concluded that right whales rarely visit the Hawaii area. Scammon (1869) reported that right whales were low in abundance along the California coast as compared to the area near Kodiak Island. Based on recent information from bottom-mounted acoustic recorders, right whales may occur in a small area within the eastern Bering Sea through October (M. Payne, cited in Alaska Scientific Review Group, 2001). Whalers described that right whales would gather into large groups near the end of the whaling season, a phenomenon they interpreted as the whales readying to migrate from the grounds for the winter (Scammon, 1869).

It is not known where calving and/or breeding of eastern North Pacific right whales occurred historically or occurs now. Lack of historical observations of calves "…suggests that neither the west coast of North America nor the Hawaiian Islands constituted a major calving ground…within the past 200 years" (Perry, DeMaster, and Silber, 1999c:45). Courtship behavior has been observed in the southeastern Bering Sea, but the National Marine Fisheries Service (67 *FR* 7662) points out that this does not necessarily indicate this is a breeding location. Nothing is known about the current population structure (for example, sex and age segregation or structure) of this stock.

Plots of sightings from catcher boats (Omura et al., 1969) suggested that, in the mid 1960's, North Pacific right whales were "most numerous off the Kuril Islands, south Okhotsk Sea and between the eastern Aleutian Islands and Kodiak Islands" (Braham, 1986). Data from these sightings suggested that some North Pacific right whales migrated seasonally into the Bering Sea by June and stayed all summer, a pattern consistent with earlier whaling data and the habits of Southern Hemisphere and North Atlantic right whales (Braham, 1986). Whales sighted in the 1940's through 1957 near the Aleutian Islands were suggested to belong to a "Kodiak Ground" stock (Omura, 1958).

There a high degree of uncertainty about how many North Pacific right whales existed prior to exploitation (Brownell et al., 2001; Angliss and Lodge, 2002) and about how many currently may exist in both eastern and western Pacific stocks (Brownell et al., 2001). An estimated 15,374 right whales were killed by American-registered vessels in the North Pacific between 1835 and 1909, with most taken before 1875 (Best, 1987; International Whaling Commission, 1986). Total harvests of North Pacific right whales have been estimated variously at 20,000 (du Pasquier, 1986) and between 26,500 and 37,000 (Scarff, 2001). By about 1865 when modern whaling began, right whales were rare worldwide (Best et al., 2001).

A remnant population (or populations) survived exploitation in the eastern North Pacific. The range of a remnant population clearly included the Gulf of Alaska. Whaling harvest data clearly indicate that as recently as the 1960's, some hundreds of right whales inhabited the eastern North Pacific, with their range including at least parts of the Gulf of Alaska and the Bering Sea (Doroshenko, 2000) (see the following).

Data from Doroshenko (2000) documents that 252 right whales were taken illegally by Soviet whalers in the Gulf of Alaska alone between 1963 and 1966 (141, 88, 20, and 3, respectively) (data taken from Brownell et al., 2001:Table 3.2). Thus, as recently as the 1960's, the Gulf of Alaska was an area of significant abundance for North Pacific right whales. The decline in catch over the 4 years probably is indicative of depletion. After 1966, eight sightings have been made of right whales in the Gulf of Alaska, including the area south of the Alaska Peninsula. Three other sightings were made south of the Aleutians (information extracted from Brownell et al., 2001). Sightings and takes of right whales in the eastern North Pacific since 1950 from the Gulf of Alaska region are extracted from Tables 2.2 and 3.2 in Brownell et al. (2001) and presented in Table III.B-4. Between 1960 and 1978, Japanese whaling scoutboats and catcherboats reported 26 right whale sightings in the Gulf of Alaska (Wada, 1975, 1978; Brownell et al., 2001). There are indications that the whales were typically present seasonally. While scout boats were in the Gulf of Alaska from May to September, right whales were only observed from June through August. Waite, Wynne, and Mellinger (In press) reported that seven right whale sightings (note: this does not refer to the number of whales, but the number of events) were reported from the Gulf of Alaska from 1959 through 1997 through the National Marine Mammal Laboratory's Platforms of Opportunity Program, and one sighting (in Yakutat Bay in 1979 of four whales) was positively identified. None of these sightings was in the winter (Waite, Wynne, and Mellinger, In press). No right whales were observed during a ship survey conducted between mid-June and late August 1980 in the Gulf of Alaska from Cape Fairweather to Chirikof Island, and including Shelikof Strait, Yakutat and Icy bays, Prince William Sound, and coastal waters from Chirikof to Dutch Harbor (Rice and Wolman, 1982). No right whales were observed during a ship survey in 1994 between the south tip of Kodiak Island along the south side of the Alaska Peninsula and the Aleutian Islands (Forney and Brownell, 1996).

The most recent confirmed sighting of a North Pacific right whale near the proposed sales area was of a single individual in the Gulf of Alaska south of Kodiak Island in July 1998 (Waite, Wynne, and Mellinger, In press). Postobservation acoustic monitoring between May 26 and September 11, 2000 identified potential right whale vocalizations in September 2000 (Waite, Wynne, and Mellinger, In press). However, these sounds were intermixed with probable humpback vocalizations and, thus, it is unclear which species produced the calls (Waite, Wynne, and Mellinger, In press). The authors point out that the lack of other right whale calls does not mean that right whales were absent. They may have been absent, present outside of detection of the hydrophone, or present but silent. A National Marine Fisheries Service observer reported 30-40 "probable" right whales in an area offshore the southcentral coast of Kodiak Island. However, Waite, Wynne, and Mellinger (In press) reported skepticism about the report because of conflicting reports from other observers and the occurrence of many gray whales in the same region in previous years.

A reliable minimum estimate of current population size is not available, nor is a reliable estimate of the current trend of the eastern North Pacific right whale population stock (Brownell et al., 2001; Angliss and Lodge, 2002). Reliable estimates of the total number of North Pacific right whales (in the western and the eastern Pacific) are not available (Brownell et al., 2001). Most modern sightings have been of single individuals or very small groups (for example, data summarized in Omura, 1958; Reeves and Leatherwood, 1985; Rowntree et al., 1980; Brownell et al., 2001). Recently (1996-2000) small aggregations (3-13) of right whales have been sighted in June or July in the southeastern Bering Sea (most of the sightings) or in Bristol Bay (for example, Goddard and Rugh, 1998; C. Tynan, pers. commun., as cited in Angliss and Lodge, 2002; LeDuc et al., 2001). Little sighting effort has occurred in other areas of the eastern Bering Sea (Alaska Scientific Review Group, 2001). Genetic analyses indicated that five per five individuals sampled in 1999 were males (LeDuc et al., 2000 cited in Angliss and Lodge, 2002). Angliss and Lodge (2002:173) summarize that "…only 14 individual animals have been photographed during aerial surveys during 1998, 1999, and 2000" and that "mark-recapture" data are "…consistent with a very small population size." Until August of 2002, a confirmed cow/calf sighting had not been reported since 1900 (D. Rice, pers. commun., cited in Angliss and Lodge, 2002:172). A confirmed cow/calf sighting was made in the southeastern Bering Sea on August 24, 2002 (Moore, 2002b, pers. commun.) during the course of a right whale study in the area. In April 1996, one individual was observed off of Maui (D. Salden, cited in Angliss and Lodge, 2002), the first documented sighting of a right whale near Hawaii since 1979 (Angliss and Lodge, 2002). The individuals recently cited in the southeastern Bering Sea (Goddard and Rugh, 1998; Tynan, 1999; Brownell et al., 2001) may represent a remnant population of the eastern North Pacific stock of the North Pacific right whale. Brownell et al. (2001) have concluded that it is unlikely that the numbers of this stock of North Pacific right whales are greater than a few dozen. While limited systematic and quantitative data suggest that the Western Stock of the North Pacific right whale may number in the high hundreds (Miyashita and Kato, In press), these estimates have wide confidence intervals, and population size is uncertain. Some other estimates "…appear to be little more than conjecture" (see examples in Brownell et al., 2001:283).

III.B.4.b(4)(f) Foraging Ecology and Feeding Areas

Right whales are specialized as skim feeders, swimming below or at the surface of the water with their mouths wide open through swarms of prey (Braham and Rice, 1984). They feed primarily on calanoid copepods and euphausiids (krill) (Omura et al., 1969). Recently, the National Marine Fisheries Service stated that North Pacific right whales feed almost exclusively on calanoid copepods (67 *FR* 7661). Braham and Rice (1984) specified that they feed on *Calanus cristatus* and *C. plumchrus* in the North Pacific (for example, Omura et al., 1969; Omura, 1986; Klumov, 1962; Nemoto, 1963) and sometimes *Euphausia pacific* (also referred to by the National Marine Fisheries Service, 1991a). Additional species previously identified as right whale prey in the North Pacific include *C. finmarchicus* and *Metrida* spp. (Omura, 1958; Omura et al., 1969; National Marine Fisheries Service, 1991a). Zooplankton species collected in 1997 on the Middle Shelf Domain of the continental shelf in the Southeast Bering Sea in the vicinity where right whales were observed were *Calanus marshallae*, *Pseudocalanus newmani* and *Acartia longiremis* (Tynan, 1999). Right whales sightings in the southeastern Bering Sea in 1999 also were associated with concentrations of copepods. The copepod concentrations recorded in 1997 in this middle shelf domain region of the Bering Sea was the highest recorded since the 1980's (Napp and Hunt, 2001). Tynan (1999) suggested that the historical distribution of North Pacific right whales may indicate that they tracked the Bering Slope Current and movement of Alaska stream waters into the Bering Sea. She also suggested they may have shifted their foraging grounds in response to changes in prey density in the region they were observed. A stated basis of the National Marine Fisheries Service's reluctance to designate critical habitat in this vicinity was the argument that the presence of right whales in this area may be transitory based on anomalous conditions (67 *FR* 7661). There is relatively little information about North Pacific right whale foraging patterns and locations on which to characterize the typical from the atypical.

Historical data indicate that the areas of the Gulf of Alaska adjacent to the Kenai Peninsula, near Kodiak Island, and south of Kodiak to the Shumagins were important feeding areas to the North Pacific right whale.

III.B.4.b(4)(g) Reproductive and Survival Rates

No data are available about current reproductive and/or survival rates for North Pacific right whales.

III.B.4.b(4)(h) Sources of Mortality and Other Factors Potentially Influencing Recovery

All right whale populations were severely exploited and depleted by commercial whaling, and available information indicates that this exploitation is the primary cause of their current severe depletion. Information from catch levels and areas of whaling indicate that intensive commercial exploitation, beginning (with respect to the North Pacific right whale) in 1800 in Baja California and in 1835 on the "Kodiak ground"(Scarff, 1986), led to the severe reduction of right whales in the eastern North Pacific within about 14 years. Due to additional unrelenting whaling in the western North Pacific, North Pacific right whales were considered rare (Scarff, 1991). Although commercial hunting was banned, North Pacific right whales continued to be taken for scientific study (for example, six north of the Aleutian Islands in the southern Bering Sea (1962-1963), including right whales taken from areas near Kodiak Island (for example, 1961: three just south of Kodiak Island) (Omura et al., 1969, Tsuyuki and Naruse, 1963). Recent evidence indicates that illegal Soviet commercial whaling in the 1960's likely decimated the already severely depleted surviving remnant population, leading to its current highly depleted status extinction (Doroshenko, 2000; Brownell et al., 2001).

No information is available about natural causes or rates of mortality of right whales in the North Pacific. Based on photo-identification data, Kraus (1990) estimated that average annual mortality rates were 17% for first-year animals and 3% for second- through fourth-year whales (Perry, DeMaster, and Silber, 1999c). Some North Atlantic right whales have been observed to carry what are classified as scars from killer whale attacks (Kraus, 1990), but rates of mortality associated with killer whales are unknown. Extremely small population size could be a factor limiting the recovery of right whale populations Reeves, Mead, and Katona (1978). There are several ways that small population size could hamper recovery. Individuals may have difficulty finding mates (Allen, 1974). Due to the extremely small population size of right whales in the eastern North Pacific, there is risk of loss of genetic variability due to obligatory inbreeding and genetic drift and potentially decreased long-term viability due to this loss (for example, due to reduced ability to respond to perturbations, greater susceptibility to disease, etc. (for example, see Nei, Maruyama, and Chakraborty, 1975 and O'Brien et al., 1985).

It is not know what natural or human-related factors currently may be negatively impacting the North Pacific right whales. The National Marine Fisheries Service (1991a) discussed the possible effects of the following human-related factors on North Pacific right whales:

- ship collisions,
- disturbance from vessels,
- entrapment and entanglement in fishing gear,
- habitat degradation, and
- hunting.

However, the current rarity of this species, and especially of the stock, makes it difficult or impossible to evaluate causes of mortality or injury in the stock (Angliss and Lodge, 2002) other than the impact of whaling (a form of hunting).

There is no information on incidence of disease, levels of contaminants, effects of noise, or other potential threats to eastern North Pacific right whales. There is no evidence of pollution-related mortality or injury. There is no evidence of Native take.

In the North Atlantic and the Southern Hemisphere, entanglement in fishing gear (including gillnets, herring weirs, lobster and crayfish lines) and ship strikes are documented significant sources of mortality to that species of right whale (see the following) and these sources could pose a threat to the similar, slow-swimming, large, North Pacific right whales, particularly if they do, or begin to, inhabit areas of the Bering Sea or Gulf of Alaska where high levels of commercial fishing occurs or where high levels of ship activity occur (for example, near Dutch Harbor). Vessel-related mortality rates for this stock are unknown (Perry, DeMaster, and Silber, 1999c). There is no evidence of fisheries interactions with this stock (Angliss and Lodge, 2002). The present known distribution of this stock of right whales does not overlap with areas where gillnets are used in fishing (M. Payne, cited in Alaska Scientific Review Group, 2001), but discarded or lost gear could affect animals far from the site of net use. There are few data on fishery interactions with North Pacific right whales. Angliss and Lodge (2002) report that only one fishery-related (gillnet entanglement) mortality has been reported for North Pacific right whales, occurring off of the Kamchatka Peninsula in 1989 (Kornev, 1994). No entanglements of right whales have been reported by fishery observers, who are required on many of the large vessels in the Bering Sea (67 *FR* 7662).

In the North Atlantic, "…direct and indirect impacts from human activities-mostly in the form of vessel collisions and entanglement in fishing gear almost certainly have contributed to a lack of recovery…" (National Marine Fisheries Service, 2001a:1). Data from the western North Atlantic indicate that fishing entanglement is a significant enough source of injury or mortality to right whales in that area (Kenney and Kraus, 1993) to merit the establishment of Take Reduction Teams charged with development of measures to reduce fishery take. An estimated 57% of right whales in the western North Atlantic have injuries or scars indicative of fishing-gear entanglement (Kraus, 1990). An estimated 7% of the known mortality of North Atlantic right whales was due to entanglement in fixed gear (Kenney and Kraus, 1993). In the North Atlantic, ship strikes are the greatest known cause of right whale mortality, accounting for 22% of 27 documented mortalities from 1970-1991 (Perry, DeMaster, and Silber, 1999c).

Perry, DeMaster, and Silber (1999c:20) concluded "…the primary factor influencing…recovery…" (of North Atlantic right whales) "…involves their occurrence in coastal habitats. This…places them in direct contact with shipping traffic, fishery operations, coastal oil and gas development, and other human activities." They examine the five factors referred to in the Endangered Species Act as factors that could possibly be influencing the recovery of North Pacific right whales. Perry, DeMaster, and Silber (1999c) stated that the possible influence of overutilization for commercial, recreational, scientific, or educational purposes, disease or predation, and inadequacy of existing regulatory mechanisms are all unknown. With respect to the present or threatened destruction or modification of habitat in the North Pacific, they specified offshore oil and gas development and referred to noise disturbance and oil spills as examples of negative factors associated with such activity. Lastly, they listed entanglement in fishing gear (for example, drift gillnets) as other natural or human-made factors that could be influencing recovery in the North Pacific.

III.B.4.b(5) Fin Whale (*Balaenoptera physalus*) – Endangered

III.B.4.b(5)(a) Summary

Fin whales regularly inhabit areas near the proposed multiple-sales area including Shelikof Strait, bays on Kodiak Island (especially on the west side), and the Gulf of Alaska (see Map 12). Some or all of these areas are feeding areas for fin whales. Information indicates that the distribution and relative abundance of fin whales in these areas varies seasonally, but there is documented use of parts of the Kodiak Archipelago/Shelikof Strait region in most months (Mizroch et al., In prep.; Zweifelhofer, 2002, pers. commun.).

We focus our description and subsequent evaluations on fin whales in the Northeast Pacific and, where appropriate, to fin whales in the North Pacific. We include information on fin whales in the North Atlantic and in the Southern Hemisphere, where it enhances our understanding of fin whales in the Northeast Pacific.

III.B.4.b(5)(b) Basic Description

Fin whales are large, fast-swimming baleen whales, second in length only to the blue whale (*B. musculus*) (Reeves, Silber, and Payne (1998). Adults range between 20 and 27 meters (~65-89 feet) in length. Adult females grow to a larger size than males (Reeves, Silber, and Payne, 1998; Perry, DeMaster, and Silber, 1999d). Antarctic fin whales generally are longer than Northern Hemisphere whales by about 3 meters (~9.8 feet) (Reeves, Silber, and Payne, 1998).

III.B.4.b(5)(c) Current Subspecies and Stock Definitions

Two subspecies of fin whales have been recognized by some authorities: the large, Southern Hemisphere form and the smaller, Northern Hemisphere form (Tomilin, 1946 cited in Reeves, Silber and Payne, 1998; Tomilin, 1967; Sokolov and Arsen'ev, 1994, cited in Reeves, Silber and Payne, 1998). Southern Hemisphere and Northern Hemisphere stocks are believed not to mix, or to rarely mix (Reeves, Silber and Payne, 1998). Fin whales and blue whales occasionally interbreed in both the North Pacific (Doroshenko, 1970) and North Atlantic (Bérubé and Aguilar, 1998).

There is uncertainty about the stock structure of fin whales in the North Pacific due to limited information (Angliss and Lodge, 2002) about movements of individuals and genetic structure. As a result, there is a lack of consistency among national and international regulatory entities in the number of stocks recognized, which has varied from two to five. To take a conservative management approach, Angliss and Lodge (2002) recognizes three population stocks of fin whales in U.S. Pacific waters: an Alaska or Northeast Pacific Stock, a California/Washington/Oregon Stock, and a Hawaii Stock. However, tag recoveries (Rice, 1974) indicate that animals whose winter habitat includes the coast of southern California summer in locations from central California to the Gulf of Alaska; and individuals from the North American Pacific coast have been reported at locations as varied as central Baja California to the Bering Sea in the summer. Based on blood typing, morphology, and marking data, Fujino (1960) identified three "subpopulations" of fin whales in the North Pacific: the East China Sea, the eastern sides of the Aleutians, and the western sides of the Aleutians (Donovan, 1991). After examination of histological and tagging data, Mizroch, Rice, and Breiwick (1984b) suggested five possible stocks. In 1971, the IWC divided North Pacific fin whales into two management units for the purposes of establishing catch limits: the East China Sea Stock and the rest of the North Pacific (Donovan, 1991). Angliss and Lodge (2002) report that based on limited geographic information indicating continuous distribution in winter but possible isolation of groups in summer, the International Whaling Commission classifies all North Pacific fin whales as a single stock (Mizroch, Rice, and Breiwick, 1984b) but cite information supportive of the existence of subpopulations in the North Pacific (see also Reeves, Silber, and Payne, 1998) for the same summary.

III.B.4.b(5)(d) Current Status and Protective Legislation

Fin whales were listed as endangered under the ESA in 1973 (Perry, DeMaster, and Silber, 1999d) and as depleted under the Marine Mammal Protection Act. Under the 1994 amendments to the Marine Mammal Protection Act, they are categorized as a strategic stock. They are listed in Appendix I of CITES (Reeves, Silber and Payne, 1998). Hunting of fin whales in the North Pacific was regulated under the 1946 International Convention for the Regulation of Whaling, which limited the legal take in the North Pacific to individuals of 55 feet (16.8 meters) or longer. The International Whaling Commission began managing the commercial take of fin whales in the North Pacific in 1969 (Allen, 1980; Reeves, Silber and Payne, 1998). Legal commercial take of fin whales in the North Pacific was prohibited by the International Whaling Commission in 1976. In July 1998, the National Marine Fisheries Service released a joint Draft Recovery Plan for the Fin Whale *Balaenoptera physalus* and Sei Whale *Balaenoptera borealis* (Reeves, Silber, and Payne, 1998). No critical habitat has been designated or proposed for fin whales in the North Pacific.

III.B.4.b(5)(e) Current and Historic Abundance

The National Marine Fisheries Service has concluded that there is no reliable information about population abundance trends nor reliable estimates of minimum abundance (Angliss and Lodge, 2002), current or historical abundance, maximum net productivity, or of the potential biological removal for the entire Northeast Pacific fin whale stock (Angliss and Lodge, 2002). However, Reeves, Silber, and Payne (1998:22) point out that the absence (Stewart et al., 1987) or scarcity (Forney and Brownell, 1996) of fin whales in areas where significant numbers were taken during whaling appears to indicate that "fin whales remain seriously depleted in these northern waters where they were subject to intense whaling, although…may also be linked to shifts in distribution or incomplete survey coverage." A rough estimate of 4,951 (95% CI 2,833-8,653; CV = 0.29) fin whales in the Bering Sea in the summer was made based on visual survey data. Perry, DeMaster, and Silber (1999d) reported a 1991 estimate of 14,620-18,630 (Braham, 1991) for the entire North Pacific.

Ohsumi and Wada (1974) previously estimated there were 42,000-45,000 fin whales in the North Pacific prior to commercial exploitation. However, recently summarized information (International Whaling Commission Bureau of International Whaling Statistics data, unpublished, cited in Angliss and Lodge, 2002) indicates that 46,032 fin whales were reported killed throughout the North Pacific between 1946 and 1975.

III.B.4.b(5)(f) Historic and Current Distribution Patterns

Mizroch et al. (In prep.) recently have summarized information about the patterns of distribution and movements of fin whales in the North Pacific available from whaling harvest records, whaling, systematic scientific, and opportunistic sightings, acoustic data from offshore hydrophone arrays, and from recoveries of marked whales. Based on their analyses, and on other references cited in the following, available information indicates that patterns of distribution are as summarized in the following.

Fin whales are widespread throughout temperate oceans of the world (Leatherwood et al., 1982; Perry, DeMaster, and Silber, 1999d; Reeves, Silber and Payne, 1998). Most fin whales are believed to migrate seasonally from relatively low latitude winter habitats where breeding and calving take place to relatively high latitude summer feeding habitats (Perry, DeMaster, and Silber, 1999d). However, the degree of mobility of populations differs, presumably in response to patterns of distribution and abundance of their prey (Reeves, Silber and Payne, 1998). Some populations migrate seasonally up to thousands of kilometers, whereas others are resident in areas with adequate prey (Reeves, Silber and Payne, 1998). A pattern of seasonal movement from lower latitude winter breeding and calving habitats to more northerly, high latitude summer feeding habitats can be observed for many, but not all, individual or even local populations of fin whales (Mizroch et al., In prep.). Data from marked fin whales indicate that at least some individuals make long movements between wintering areas off Mexico and California to summer feeding areas in the Gulf of Alaska (Mizroch et al., draft manuscript).

Angliss and Lodge (2002) reported that fin whales in the North Pacific generally are reported to be off the North American coast and Hawaii in winter and in the Bering Sea in summer. Mizroch et al.'s (draft manuscript) summary indicates that the fin whales range across the entire North Pacific from April to October, but in July and August they concentrate in the Bering Sea-eastern Aleutian area. It is clear from their sighting summary that during many different times of the year, fin whales have been observed in widely scattered locations throughout their range in the North Pacific. In January and February, fin whales have been sighted off Baja California, in the Aleutian area, and Bering Sea. In the 1960's, 20 fin whales were sighted in the Gulf of Alaska in January (Berzin and Rovnin, 1966). In March, concentrations of fin whales have been seen around Kodiak Island, sightings are reported off California and Oregon, and yet they are still observed in Baja California and in the Bering Sea. In April, sightings are reported all along the coast of the United States and Canada, but sightings are concentrated around Kodiak Island. In May-July, sighting data indicate high use of the Gulf of Alaska and, in June and July, in the Bering Sea, while August data show fewer sighting in the Gulf of Alaska. In September and October, sightings indicate that fin whales are in the Bering Sea, the Gulf of Alaska, and along the U.S. coast as far as Baja California (in October). In November, fin whales are still observed in the Kodiak region and in southern California, while in December, sightings have been primarily along Baja California and in the Gulf of California (Mizroch et al., In prep.). Mizroch et al. also confirmed that fin whales from both sides of the Pacific concentrate in the Bering Sea-eastern Aleutian Island area in July and August and move along the continental shelf edge following the retreating ice.

Passive acoustic data (McDonald and Fox, 1999) document that Hawaii is used in the winter by fin whales but indicates that densities are likely lower than those in California (Barlow, 1995; Forney, Barlow, and Carretta, 1995). However, as evident from material summarized in the previous paragraph, observations summarized by Mizroch et al. (In prep.) demonstrate that there are many fin whales in northerly waters in winter months. These observations are not in agreement with typical summaries of fin whale distribution, which state that essentially all fin whales migrate from summer feeding grounds to wintering areas in the south. However, Mizroch et al. (In prep.) point out that this view of fin whale distribution was based primarily on data showing that whaling was rarely done from November to May in high latitude whaling areas. They note that this fact probably resulted both from a scarcity of whales and severely adverse winter weather (Mizroch et al., In prep.). Mizroch et al. do point out, however, that fin whales with small calves have not been seen during the winter months, and that it has not been demonstrated that individual whales are year-round residents in the northern areas.

Reeves, Silber and Payne (1998) reported that fin whales tend to feed in summer at high latitude and fast, or feed little at winter lower latitude habitats (Reeves, Silber and Payne, 1998). However, recent data on fin whale presence based on calls detected by bottom-mounted hydrophones document high levels of fin whale call rates along the U.S. Pacific coast from August to February (Moore et al., 1998; Watkins et al., 2000). The patterns of fin whale calls detected "…generally corresponded to seasonal productivity in the areas monitored…" (Moore et al., 1998:623) and have been interpreted as a possible indication of the importance of this area for fin whale feeding during winter (Angliss and Lodge, 2002). During visual cetacean surveys in July and August 1999 in the central Bering Sea, "…aggregations of fin whales were often sighted in areas where the…echo sounder…identified large aggregations of zooplankton, euphausiids, or fish" (Angliss, DeMaster, and Lopez, 2001:160). Mizroch et al. (In prep.) concluded that catch densities and sightings show concentrations of fin whales within a highly productive "Bering Sea Green Belt" along the shelf edge (Springer, McRoy, and Flint, 1996).

The importance of specific feeding areas to populations or subpopulations of fin whales is not yet understood. In the North Atlantic, 30-50% of identified individual fin whales returned to specific feeding areas in subsequent years (Seipt et al., 1990). The timing of arrival at feeding habitats can vary by sex and reproductive status, with pregnant females arriving earlier (Mackintosh, 1965).

III.B.4.b(5)(g) Use of Areas Near the Proposed Cook Inlet Multiple-Sales Area

During opportunistic sightings of fin whales by Kodiak National Wildlife personnel, fin whales have been observed in the vicinity of Kodiak Island, especially in Uganik and Uyak bays, every month of the year except December and January (Zweifelhofer, 2002, pers. commun.; Mizroch et al., In prep.). Especially large concentrations were observed during February, April, and November (Mizroch et al., In prep.). Mizroch et al. concluded that fin whales likely are present in waters of Shelikof Strait, off the Kodiak Archipelago, and other northerly areas in winter because of the presence and distribution of their prey, including forage fish. Fin whales have been observed feeding in bays adjacent to Kodiak Island, including Uganik and Uyak bays (Zweifelhofer, 2002, pers. commun.). Mizroch et al. (In prep.) summarizes that Shelikof Strait provides year-round foraging opportunities for many species. Thus, fin whales use the Kodiak/Shelikof Strait regions in all seasons, and the area appears to be an important, possibly year-round, feeding area for this whale species.

III.B.4.b(5)(h) Foraging Ecology and Feeding Areas

Based on observations from whaling operations, Nemoto and Kasuya (1965) reported that fin whales feed in shallow coastal areas and marginal seas in addition to the open ocean. Citing the International Whaling Commission (1992a), Perry, DeMaster, and Silber (1999d) report that there is great variation in the predominant prey of fin whales in different geographical areas, depending on which preys are locally abundant. While they "depend to a large extent on the small euphausiids and other zooplankton" (Perry, DeMaster, and Silber, 1999d:49), reported fish prey species in the Northern Hemisphere include capelin, *Mallotus villosus*; herring *Clupea harengus*; anchovies, *Engraulis mordax*; and sand lance, *Ammodytes* spp). Based on the stomach contents of whales killed during commercial whaling in the 1950's and 1960's, (Nemota and Kasuya, 1965) reported that in the Gulf of Alaska, *Euphausia pacifica*, *Thysanoessa inermis*, *T. longipes*, and *T. spinifera* are the primary prey of fin whales. Mizroch et al. (In prep.) summarized fish, especially capelin, Alaska pollock, and herring are the main prey north of 58° N. latitude in the Bering Sea. Reeves, Silber, and Payne (1998) reported the above species as primary prey in the North Pacific and also listed large copepods (mainly *Calanus cristus*), followed by herring, walleye pollock (*Theragra chalcogramma*), and capelin. Mizroch et al. (In prep.) summarize that fin whales appear to be able to make long-distance movements quickly to track prey aggregations and are capable of switching their diet from krill to fish as they migrate northward. They aggregate where prey densities are high (Piatt and Methven, 1992; Piatt et al., 1989; Moore et al., 1998). Such concentrations of fin whale prey often occur in areas with high phytoplankton production and along ocean fronts (Moore et al., 1998). These features, in turn, often are associated with the continental shelf and slope and other underwater geologic features such as seamounts and submarine canyons (Steele, 1974; Boehlert and Genin, 1987; Dower, Freeland, and Juniper, 1992; Moore et al., 1998).

III.B.4.b(5)(i) Reproductive Biology

Knowledge of the reproductive biology of endangered species is important, because it provides information about the ability of depleted populations to recover, provides a basis for evaluating potential time courses of recovery, and provides information about habitat requirements of the listed species. Lockyer (1972) reported the age at sexual maturity in fin whales, for both sexes, to range from 5-15 years, while the average length is approximately 17.2 meters (see references in Perry, DeMaster, and Silber, 1999d). Based on analyses of age of sexual maturity in North Pacific fin whales killed from the mid-1950's to 1975, Ohsumi (1986) detected a decline in age of first reproduction from 12 to 6 years old in females and from 11 to 4 in males, a phenomenon interpreted by Ohsumi as a response to heavy exploitation (Reeves, Silber, and Payne, 1998). Fin whales are thought to generally mate and calve while on wintering grounds (Perry, DeMaster, and Silber, 1999d). Available information indicates that a single calf is born after a gestation of about 12 months and weaned between 6 and 11 months of age (Best, 1966; Gambell, 1985) on the summer grounds (Mizroch et al., In prep.). Calving intervals range between 2 and 3 years (Agler et al., 1993). Mizroch et al. (In prep.) summarized that about 35-40% of adult fin whale females give birth in any given year.

III.B.4.b(5)(j) Sources of Mortality and Other Factors Potentially Influencing Recovery

Most stocks of fin whales were depleted by commercial whaling (Reeves, Silber and Payne, 1998) beginning in the second half of the mid-1800's (Schmitt, de Jong, and Winter, 1980; Reeves and Barto, 1985). In the 1900's, hunting for fin whales continued in all oceans for about 75 years (Reeves, Silber and Payne, 1998) (see information on whaling level in Section III.B.4.b(5)(e) – Current and Historic Abundance). It is likely that reports of Soviet takes of fin whales in the North Pacific are unreliable (Reeves, Silber and Payne, 1998), because evidence indicates the Soviets over-reported fin whale catches by about 1,200, presumably to hide takes of species such as right whales and other protected species (Doroshenko, 2000). In 1965, Nemoto and Kasuya (1965) reported that fin and sei whales were the primary species taken in the Gulf of Alaska during Japanese commercial whaling in recent catches. Figure 1 of that report documents that in 1963, more than 150 fin whales were taken just south of the Kenai Peninsula. Other areas of high take in 1963 were especially southeast Alaska and areas offshore between Prince William Sound and Glacier Bay. Multiple smaller groups were taken offshore of areas south of Kodiak Island and the Alaska Peninsula to Unimak Pass, and large numbers were taken throughout the northern Gulf in an area bounded on the south at approximately 53° N. latitude. Legal commercial hunting ended in the North Pacific in 1976.

There is no evidence of subsistence take of fin whales in the Northeast Pacific (Angliss, DeMaster, and Lopez, 2001; Angliss and Lodge, 2002).

There is little information about natural causes of mortality (Perry, DeMaster, and Silber, 1999d). In 2002, the National Marine Fisheries Service summarized that "There are no known habitat issues that are of particular concern for this stock" (Angliss, DeMaster, and Lopez, 2001; Angliss and Lodge, 2002). Documented human-caused mortality of fin whales in the North Pacific since the cessation of whaling is low. Perry, DeMaster, and Silber (1999d:51) list the following factors possibly influencing the status of fin whales in the North Pacific: offshore oil and gas development as a "Present or threatened destruction or modification of habitat; and vessel collisions as an "Other natural or man-made factor." The possible influences of disease or predation and of overutilization are listed as "Unknown." Documented fishery-interaction rates are very low in the North Pacific. However, the only information available for many fisheries in the Gulf of Alaska comes from self reporting of individual fishers. Such data are likely biased downwards. Based on the death in 1999 of a fin whale incidental to the Bering Sea/Aleutian Island groundfish fishery, the National Marine Fisheries Service estimates three mortalities in 1999 and an average yearly take of 0.6 (CV = 1.) between 1995-1999 (Angliss and Lodge, 2002). In the North Atlantic, nine entanglements were recorded in the National Marine Fisheries Service Northeast Regional entanglement database between 1975 and 1992 (Blaylock et al., 1995), and three other instances indicating entanglement were recorded between 1992 and 1996 (Waring et al., 1998). In the North Atlantic, there is concern about the potential impact of overexploitation of certain fish stocks on fin whales (Perry, DeMaster, and Silber, 1999d). The reported instance of fin whale deaths due to vessel strikes is low. One fin whale death due to vessel strike was reported in the North Pacific in 1991 (Perry, DeMaster, and Silber, 1999d), and a fin whale was struck by a vessel in Uyak Bay in 2000. In the North Atlantic, there is documented effect on behavior from whale watching and other recreational boat encounters and from commercial-vessel traffic (for example, Stone et al., 1992) but also evidence of habituation to increased boat traffic (Watkins, 1986). Perry, DeMaster, and Silber (1999d) summarized that noise from seismic exploration did not appear to affect fin whales in detectable ways (McDonald et al., 1993).

III.B.4.b(6) North Pacific Sei Whale Population (*Balaenoptera borealis*) Endangered

III.B.4.b(6)(a) Summary and Basic Description

Sei whales are large baleen, rorqual whales. Adult females attain larger size than do adult males, with a maximum length of 18.6 meters (~61 feet) in the North Pacific Ocean (Gambell, 1985). Sei whales are found in all oceans (National Marine Fisheries Service, 2001a) but are less likely than many other baleen whales to venture into frigid polar waters (Gambell, 1976, 1985; Rice, 1998). Sei whales also tend to inhabit open ocean and are not usually found in coastal, inshore waters. Sei whales are not known to occur in the proposed multiple-sales area but have recently been reported near the west side of Kodiak Island (see Map 12).

As with many of the endangered cetaceans, there is a lack of reliable data and related uncertainty about abundance, population structure, population trends and status, levels and causes of variability in basic life-history parameters, and factors that could be affecting recovery. For details on sei whale history, ecology, conservation issues, and other topics that are beyond the scope of this document, we refer the reader to *the Draft Recovery Plan for the Fin Whale Balaenoptera physalus and Sei Whale Balaenoptera borealis* (Reeves, Silber, and Payne, 1998), to the recent status review by Perry, DeMaster, and Silber (1999e), and to recent stock assessments (Carretta et al., 2001).

III.B.4.b(6)(b) Knowledge of Population Structure and Designation of Population Stocks

There is not definitive information about the number of populations of sei whales in the North Pacific, their boundaries, or the interrelationships of populations. There is some evidence for multiple populations (Masaki, 1977; Mizroch, Rice, and Breiwick, 1984c); Horwood, 1987). Based on sightings, tag recoveries, catch distributions, and baleen morphology, Masaki (1977) proposed the recognition of three stocks of sei whales in the North Pacific, divided by longitudes 175° W. and 155° W. Tagged whales have been documented to move north from California to Washington and British Columbia (Rice, 1974). Different species of a parasite, *Penella*, were observed on sei whales taken off California versus those taken off Japan (Rice, 1977). Carretta et al. (2001) states that “Lacking additional information on population structure, sei whales in the eastern North Pacific (east of longitude 180°) will be considered a separate stock,” apparently from sei whales in the western North Pacific. The International Whaling Commission recognizes only one stock of sei whales in the North Pacific (Donovan, 1991).

III.B.4.b(6)(c) Current Status and Protective Legislation

Sei whales are listed as endangered under the ESA. Thus, the eastern North Pacific stock is categorized as depleted and as a strategic stock under the Marine Mammal Protection Act. Commercial whaling has been prohibited in the United States since 1972. The International Whaling Commission prohibited commercial whaling of sei whales in 1976 (Carretta et al., 2001).

III.B.4.b(6)(d) Historic and Current Distribution and Abundance

Sei whales primarily inhabit deepwater areas of open oceans, most commonly over the continental slope (for example, Mitchell, 1975a; Martin, 1983; Reeves, Silber, and Payne, 1998) or in “in basins…between banks” (Reeves, Silber, and Payne, 1998:23). They are rarely found in cold polar seas or in near-coastal waters. In both the North Atlantic and the North Pacific, sei whales tend not to commonly enter semienclosed water areas, such as bays, the Gulf of Mexico and the Sea of Japan (Reeves, Silber, and Payne, 1998). In the North Pacific, they occur across temperate areas north of 40° N. latitude and range as far south as Baja California in the eastern Pacific and to Japan and Korea in the western Pacific. They migrate from low latitude winter areas to higher latitude summer feeding areas. There is evidence that pregnant females are the first to migrate both into and out of feeding grounds (Masaki, 1976). The summer range in the North Pacific extends from southern California to south of the Aleutian Islands, to the Gulf of Alaska on the east and south to Japan on the west, and across the central Pacific north of the subarctic boundary (National Marine Fisheries Service, 2001a). Available evidence indicates that the range of sei whales in the Bering Sea is limited to the southeastern corner of the deep southwestern Aleutian Basin (Gambell, 1985; Rice, 1998). Sei whales generally (but see Masaki, 1977) have been reported south of the Aleutian Islands (Leatherwood et al., 1982; Reeves, Silber, and Payne, 1998). Based on evaluation of Japanese sighting data, Horwood (1987) concluded that sei whales rarely entered the Bering Sea. Sei whales in the North Pacific winter between 20º and 23º N. latitude (Masaki, 1976). Distribution may be nonrandom with respect to age, with a higher proportion of larger and older individuals in higher latitude areas (Gambell, 1985).

With respect to historic distribution and abundance, Masaki (1977) reported the whaling effort for sei whales was distributed across the North Pacific between 45° and 55° N. latitude. In the 1950's and 1960's, sei whales were the fourth most common whale taken by California coastal whalers (Rice, 1974), being present primarily in late summer to early fall. However, based on results from extensive aerial and ship surveys conducted off California in 1991, 1992, 1993, and 1994 (Hill and Barlow, 1992; Carretta and Forney, 1993; Mangels and Gerrodette, 1994; VonSaunder and Barlow, 1999), sei whales are now rare in California waters (Dohl et al., 1983; Barlow, 1997; Forney, Barlow, and Carretta, 1995; Mangels and Gerrodette, 1994) and are extremely rare south of California (Wade and Gerrodette, 1993; Lee, 1993). Pike and MacAskie (1969) described sei whales as abundant off the west coast of Vancouver Island from June through August. During aerial surveys off Oregon and Washington, Green et al. (1992) did not report any sei whale sightings.

All estimates of prewhaling abundance of sei whales in the North Pacific depend on whaling records and trends in catch or sighting rates (Reeves, Silber, and Payne, 1998). The prewhaling abundance of sei whales in the North Pacific has been estimated to be between 58,000 and 62,000 (Ohsumi and Wada, 1974) and 42,000 (Tillman, 1977). Barlow et al. (1977) summarized that 61,500 sei whales were reported killed by commercial whalers in the North Pacific between 1947 and 1987. Based on whaling catch records, Tillman (1977) estimated that the abundance of sei whales in the North Pacific declined about 80% from approximately 42,000 in 1963 to 8,600 in 1974. Between 1960 and 1970, the catch of sei whales per unit effort declined by 75% in California shore whaling (Rice, 1977), which is consistent with substantial population reduction (Reeves, Silber, and Payne, 1998).

Carretta et al. (2001) reported that there are no direct estimates of population size for sei whales based on sighting surveys for either the entire North Pacific or for the eastern North Pacific. Additionally, they reported there are no current estimates of minimum abundance for this stock or data on population trends for the eastern Pacific. Existing estimates of minimum abundance are greater than 10 years old and do not include statistical estimates of precision (Carretta et al., 2001). Expectations that there probably is a positive population trend usually are based on the fact that sei whales are protected from legal whaling and other purposeful take. However, the effectiveness of such legal protections is uncertain due to the possible impacts of illegal whaling (Yablokov, 1994), entanglement in fishery gear, and vessel strikes (Carretta et al., 2001). Additionally, other factors, such as those related to small population size and/or ecosystem change, may impede recovery. Thus, data are not available to confidently determine the population size, status, or trend of sei whales in the North Pacific.

III.B.4.b(6)(e) Use of Areas Within or Near theProposed Cook Inlet Multiple-Sales Area

Because they tend to occur in open ocean, it is unlikely that sei whales would occur within the proposed multiple-sales area, especially in the area to the north of Anchor Point. Fiscus et al. (1976:27) summarized sightings (Nemoto and Kasuya, 1965; Berzin and Rovnin, 1966; Nishiwaki, 1966) of sei whales in the Northeast Gulf of Alaska and Kodiak shelf regions. They stated: "The largest known concentration of this species in the Gulf of Alaska is during the summer…near and just east of Portlock Bank…." Between early April 1958 and mid-May 1975, 11 sightings of sei whales were reported with a total of 26 sei whales reported. The number of individuals seen ranged from one to six. Fiscus et al. (1976) speculated that sei whales may occur in the eastern and central Gulf of Alaska as right whales historically did (Townsend, 1935), because both species prey on euphausiids. No sei whales were observed during a ship survey conducted between mid-June and late August 1980 in the Gulf of Alaska from Cape Fairweather to Chirikof Island and including Shelikof Strait, Yakutat and Icy bays, Prince William Sound, and coastal waters from Chirikof to Dutch Harbor (Rice and Wolman, 1982). No sei whales were observed during a 1994 ship survey of the area south of Unimak Pass to the end of Kodiak Island (Forney and Brownell, 1996). In 2001, sei whales were observed just outside of Uyak Bay (Zweifelhofer, 2002, pers. commun.).

III.B.4.b(6)(f) Foraging Ecology and Feeding Areas

Sei whales feed using both engulfing and skimming, depending on the type of prey being captured (Nemoto, 1959, 1970; Perry, DeMaster, and Silber, 1999e). In the Atlantic Ocean, observations of feeding behavior (Watkins and Schevill, 1979) and examination of possible sei whale feces (Weinrich et al., 1986; Schilling et al., 1992) indicate sei whales have a preference for zooplankton, including calanoid copepods (*Calanus cristatus*, *C. plumchrus*, and *C. pacificus* in the North Pacific) and euphausiids (for example, *Thysanoessa inermis* and *T. longipes* in the North Pacific) in both the Atlantic and the Pacific (Hjort and Ruud, 1929; Mitchell, 1975b; Mitchell, Kozicki, and Reeves, 1986; Christiansen, Haug, and Øien, 1992). Mitchell (1975b) suggested that right whales and sei whales may compete for available copepod prey, that the decline of right whales permitted sei whales to increase in abundance, and that competition with sei whales was impeding right whale recovery. However, Clapham and Brownell (1996) examined the evidence for this hypothesis and concluded that there was no convincing evidence that competition was influencing baleen whale recovery.

In the North Pacific, sei whales also apparently can prey on a wide variety of organisms in addition to zooplankton, including fish the size of adult mackerel (Nemoto and Kawamura, 1977; Reeves, Silber, and Payne, 1998), pelagic squid (Nemoto and Kawamura, 1977; Kawamura, 1982) and, off the coast of California, anchovies (Rice, 1977). Reeves, Silber, and Payne (1998) pointed out that due to their diet, sei whales in the North Pacific may be more likely than sei whales in the Atlantic to be affected by, or to affect, commercial finfisheries.

III.B.4.b(6)(g) Reproductive Biology

Based on individuals killed off central California, Rice (1977) estimated age at sexual maturity to be 10 years. In the Atlantic, the mean age of sexual maturity for both sexes is thought to be 8-10 years (Lockyer and Martin, 1983). Rice's (1977) estimate of gestational length in the North Pacific is about 12.7 months, whereas alternative estimates for the North Atlantic range from 10.75 (Lockyer and Martin, 1983), 11.25 months (Lockyer, 1977, or 1 year (Risting, 1928).

Lactation appears to typically last about 6-9 months (Rice, 1977; Lockyer and Martin, 1983). Rice (1977) estimated average calving intervals in the North Pacific to be about 3 years and, based on work by Jonsgård and Darling (1977) and Lockyer and Martin (1983), Reeves, Silber, and Payne. (1998:25) concluded that it was "…probably at least 2 years" in the Atlantic. Weaning is thought to occur on the summer grounds (Reeves, Silber, and Payne, 1998). Rice (1977) judged calving to occur from September to March. Mating takes place during the winter.

III.B.4.b(6)(h) Longevity

Based on examination of annual growth layers in the earplug, the maximum age estimated for a sei whale was 60 years (Lockyer, 1977).

III.B.4.b(6)(i) Rates and Sources of Mortality and Other Factors Potentially Influencing Recovery

As evident from information given above, previous commercial whaling was the factor responsible for causing the endangered status of sei whales. Little is known about natural causes or rates of mortality of sei whales. There are no estimates of natural mortality for sei whales in the Atlantic (Reeves, Silber, and Payne, 1998). For sei whales in the North Pacific, Rice (1977) estimated total annual mortality rates of 0.088 for adult females and 0.103 for adult males.

Disease has been detected in sei whales in the North Pacific, but neither the frequency nor the pattern of its occurrence is well documented. More importantly, the effect of detected diseases on survival is not known.

Rice (1977) found heavy infestations of endoparasitic helminthes, including pathogenic species, in sei whales killed off of California from 1959-1970. Of 284 of these whales, 7% also exhibited symptoms of a disease that caused baleen shedding and replacement with a "…papilloma-like growth" (Rice, 1977). These whales were apparently still feeding and were not emaciated (Rice, 1977).

Sei whales may be preyed upon by orcas (Reeves, Silber, and Payne, 1998) but the frequency of such predation is not known.

III.B.4.b(6)(j) Human-Related Mortality and Habitat Concerns

In the draft recovery plan for fin and sei whales, Reeves, Silber, and Payne (1998) identified the following human-related factors that could impact the recovery of sei whales: entanglement and entrapment in fishing gear, human-caused noise, disturbance from vessels, collisions with vessels, contaminants, habitat degradation (including prey removal and noise), military operations, and hunting. Carretta et al. (2001) summarized that a habitat concern for all whales, and especially for baleen whales, is the increasing level of human-caused noise in the world's oceans. Bering Sea, Aleutian, and Gulf of Alaska groundfish trawl, longline, and pot fisheries were monitored for incidental take in 1990-1997, but no mortalities or serious injuries of sei whales were observed (Hill and DeMaster, 1999). Total estimated fishery mortality for the eastern North Pacific Stock of sei whales is zero (Carretta et al., 2001). More details on the potential effects of these factors are provided in Sections IV.B.1.f and V.C.5.f on threatened and endangered species.

III.B.4.b(7) Sperm whale (*Physeter macrocephalus*) (North Pacific Stock) – Endangered

III.B.4.b(7)(a) Summary

Sperm whales are large, toothed whales that are long lived, slow to mature, and have low reproductive rates. Although they historically have been hunted extensively for spermaceti oil taken from their oversized heads, and for other body parts, they are found in all ocean basins and are relatively abundant. They are found primarily in the open ocean and, as a consequence, little is known about their population structure and natural history. Available evidence indicates that mature males are present offshore in the Gulf of Alaska during the summer in unknown abundance, but they are very unlikely to be present in the proposed multiple-sales area (see Map 12).

III.B.4.b(7)(b) Basic Description

The sperm whale is a large, widely-distributed, member of the odontoceti, or toothed, whales. Males attain maximum lengths of 18.5 meters, whereas females reach 12.5 meters (Odell, 1992). They are distinguished by their exceptionally large, oil-rich heads, which extend about one-third of their total body length. Sperm whales generally are deep divers. Large males are capable of diving to more than 2,000 meters deep and staying submerged for more than an hour (Watkins, et al., 1993). A single blow hole is located left anterior. The bottom jaw is strikingly narrow, and holds 17-29 pairs of teeth that align with indentations in the upper jaw (Rice, 1989).

III.B.4.b(7)(c) Current Stock Definitions

Kasuya (1991) proposed three distinct sperm whale stocks in the North Pacific: northwest North Pacific, southwest North Pacific, and eastern North Pacific (see also, Bannister and Mitchell, 1980). These distinctions were based on his analysis of Japanese coastal whaling data, blood typing, tag returns, and whale distribution associated with oceanographic current systems. Distinction between the three groups is confounded by overlapping male summer distributions. However, based on limited additional information, the National Marine Fisheries Service currently recognizes three stocks of sperm whales in the eastern North Pacific, depending on the U.S. waters in which they are found: Alaska (North Pacific Stock), California/Oregon/Washington, and Hawaii (Angliss, DeMaster, and Lopez., 2001). The International Whaling Commission's Scientific Committee designated two sperm whale stocks (western and eastern) in the North Pacific in 1981 (Donovan, 1991).

III.B.4.b(7)(d) Current Status and Protective Legislation

Sperm whales are listed as "Endangered" under the ESA of 1973. Because of this status, they are designated "Depleted" and as a "Strategic Stock" under the Marine Mammal Protection Act.

The eastern North Pacific stock, as classified by the International Whaling Commission, and which includes the Alaska stock, has not been designated as a "Protected Stock" by the International Whaling Commission (Perry, DeMaster, and Silber, 1999f).

III.B.4.b(7)(e) Historic and Current Distribution Patterns

Sperm whales are found in the Gulf of Alaska, along the Aleutian Islands, and in the deeper waters of the Bering Sea primarily during the summer and tend to be mostly mature males that have moved north from wintering areas to feed. Females and juveniles are found only rarely north of lat. 50º N. (Reeves and Whitehead, 1997). Males join with female and juvenile groups in the winter and tend to be typically distributed south of lat. 40º N. (Gosho, Rice, and Breiwick, 1984). Beyond the extent of those seasonal movements, discovery tag data from commercial whaling indicated that little north-south movement occurs among north Pacific sperm whales, although considerable east-west movement appears to be exhibited between Alaskan waters and those off Japan and the Bonin Islands (Ohsumi and Masaki, 1977, Wada, 1980, B. Taylor, pers. commun., cited in Angliss, DeMaster, and Lopez, 2001). Sperm whales commonly are found in waters exceeding 300 meters' depth and often are concentrated in upwellings and along the outer continental shelf and mid-ocean areas (Rice, 1989).

III.B.4.b(7)(f) Historic and Current Abundance and Current Population Status

Although a number of estimates are summarized in Perry, DeMaster, and Silber (1999f), Angliss, DeMaster, and Lopez (2001) in the *Alaska Marine Mammal Stock Assessments, 2001*, recently concluded that reliable estimates of abundance are not available for either the North Pacific stock or the number of sperm whales in Alaska waters (see also Perry, DeMaster, and Silber, 1999f). Prior to exploitation, there were believed to be 1,260,000 sperm whales in the North Pacific, including both the Alaska and California/Oregon/Washington stocks (Rice, 1989). This number was believed to have been reduced to 930,000 following whaling. However, these numbers also currently are not considered to be reliable (Angliss, DeMaster, and Lopez, 2001).

However, Braham (1992) recently concluded that based on total abundance, distribution, and regulatory measures in place, it was unlikely that the North Pacific stock of sperm whales was in danger of extinction or threatened with becoming endangered in the foreseeable future.

III.B.4.b(7)(g) Foraging Ecology and Feeding Areas of Sperm Whales in the North Pacific

Sperm whales feed primarily on larger mesopelagic cephalopod and fish species, including the giant squid (Perry, DeMaster, and Silber, 1999f). The four most common prey of sperm whales in the North Pacific off central California are cephalopods (i.e., *Moroteuthis*, *Gonatopsis*, *Histioteuthis*, and *Galiteuthis*) (Fiscus, Rice, and Wolman, 1989).

III.B.4.b(7)(h) Reproductive Biology

Breeding takes place during spring and early summer but is not believed to occur in Alaska waters. Females are sexually mature by 9 years of age, whereas males are mature at 20 years of age. The interbirth interval is long, 4.8-6 years (Kasuya, 1991). Gestation lasts 14-16 months and lactation 1-2 years (Kasuya, 1991). Pregnancy rates typically vary from 20% in unexploited populations to 25% in exploited populations (International Whaling Commission, 1980).

III.B.4.b(7)(i) Natural Mortality

Reliable information on rates of mortality is not available (International Whaling Commission, 1980).

III.B.4.b(7)(j) Human-Caused Mortality

Available information is insufficient to accurately estimate the take of sperm whales in fisheries in the North Pacific. There are six commercial fisheries operating within the range of the North Pacific stock.

No mortalities of sperm whales have been observed by National Marine Fisheries Service fisheries observers or reported by self-reported fisheries. However, Angliss, DeMaster, and Lopez (2001) point out that the latter is incomplete and, therefore, unreliable. However, these authors report that: "…based on the lack of reported mortalities (by fishermen), the estimated annual mortality rate incidental to commercial fisheries is zero. As a result, the annual human-caused mortality is considered to be insignificant and approaching a zero mortality and serious injury rate" (Angliss, DeMaster, and Lopez, 2001).

There are no reports of subsistence hunters taking sperm whales (Rice, 1989; Angliss, DeMaster, and Lopez, 2001).

Between 1947 and 1987, 258,000 sperm whales were reported to be taken by commercial whalers in the North Pacific (C. Allison, pers. commun., cited in Angliss, DeMaster, and Lopez, 2001). However, due to underreporting by the Soviets between 1949 and 1971 by 60% (Brownell, Yablokov, and Zemsky, 1998), this number underestimates whaling take. New information suggests Japanese land-based whaling operations also under-reported during the post-World War II era (Kasuya, 1998). The Japanese officially stopped catching sperm whales in the North Pacific in 1988 (Reeves and Whitehead, 1997).

III.B.4.b(7)(k) Effects of Human-Caused Noise

Perry, DeMaster, and Silber (1999f) concluded that it is not known whether human-caused noise has adverse effects of biological significance to this species. Odell (1992) concluded that the effects of oil-production platforms and associated vessels have unknown effects on sperm whales. In the Gulf of Mexico, studies indicated that sperm whales moved greater than 50 kilometers in response to seismic pulses (Mate, Stafford, and Ljungblad, 1994). In reaction to seismic pulses up to 300 kilometers away (Bowles et al., 1994), sperm whales in the Indian Ocean stopped vocalizing. Studies are ongoing to determine whether such reactions are typical and, more generally, to determine the range of responses observed and the causes of any variation in response. Reactions of sperm whales to vessels include more erratic movements, decreased surface times, fewer blows per surfacing, shorter intervals between blows and increased frequency of dives without raised flukes, and a startle response (Whitehead et al., 1990; Cawthorn, 1992; Gordon et al., 1992).

III.B.4.b(8) Steller Sea Lions (*Eumetopias jubatus)* – Endangered (Western Population Stock); Threatened (Eastern Population Stock)

III.B.4.b(8)(a) Summary

Two designated stocks of Steller sea lions could occur within or near the proposed multiple-sales area. There is designated critical habitat and other habitat considered as critical habitat by the National Marine Fisheries Service within the proposed multiple-sales area: at Cape Douglas, the Barren Islands, and marine areas adjacent to the southwestern Kenai Peninsula, and at the extreme southern end of Cook Inlet. There is additional critical habitat, including rookeries, haulouts, and marine foraging areas for the western population stock in areas near to the proposed sales area, including Shelikof Strait, and areas along the southern side of the Alaska Peninsula. At present, the western population stock of Steller sea lions contains about 30,000-35,000 animals, is declining at about 4-5% per year, and has an excess (beyond what would be expected at that population size if stable) mortality of about 1,700 animals per year; 50-75% of this excess mortality is unexplained. Results on adult females and young of the year indicate that at present, individuals from the western declining populations are in better condition than those in the increasing eastern population, but information on weaned pups and juveniles is not sufficient to address nutritional impacts on this vulnerable age class.

The western population of Steller sea lions is expected to decline at least into the near future, whereas the eastern population "…is increasing and appears to be robust" (National Marine Fisheries Service, 2001b:181).

We provide a relatively large amount of information, especially about the western population stock of sea lions, for three main reasons:

1. There are Steller sea lions near the proposed multiple-sales area year-round.
2. There is critical habitat for this stock within and near to the proposed multiple-sales area.

3. There is a lot known about this species and population relative to many of the endangered species that can occur in the region.

For additional detail on all issues, we refer the reader to the recent Biological Opinion and Incidental Take Statement related to commercial groundfishery Fishery Management Plan (National Marine Fisheries Service, 2001b), the 2002 draft stock assessments for both stocks (Angliss and Lodge, 2002), and numerous references cited within these documents.

III.B.4.b(8)(b) Basic Description

Steller sea lions are large pinnipeds, the only living member of the genus *Eumetopias*. Their closet living relatives are other sea lions (for example, *Zalophus, Otaria*) and fur seals within the genus *Callorhinus* and *Arctocephalus*.

III.B.4.b(8)(c) Population Stock Structure and Current Stock Designations

Two population stocks of Steller sea lions were recognized in 1997, based on demographic and genetic dissimilarities (Bickham, Patton, and Loughlin, 1996; Loughlin, 1997) (62 *FR* 30772). The boundaries of these two stocks are shown in Figure III.B-3.

III.B.4.b(8)(d) Current Endangered Species Act Status and Protective Legislation

On November 26, 1990, Steller sea lions (considered as one population) were listed as threatened throughout their range under the ESA (55 *FR* 40202). After recognition of two population stocks of Steller sea lions, and continued decline, the western population of Steller sea lions was listed as Endangered under the ESA on May 5, 1997 (62 *FR* 30772). The eastern population remained listed as threatened. If steady increases in the eastern population continue, this population may be considered for delisting over the next few years (National Marine Fisheries Service, 2001b). Critical habitat for the Steller sea lion was designated on August 27, 1993 (58 *FR* 45269). A Final Recovery Plan for the Steller sea lion was published in December 1992. However, the National Marine Fisheries Service has recognized that much new information needs to be incorporated into a revised recovery plan, and new recommendations may be required. Thus, a new recovery team has been or is being formed (National Marine Fisheries Service, 2001b). Delisting criteria were developed by the previous recovery team but never adopted by the National Marine Fisheries Service. While the new recovery team will develop such criteria, no specific recovery guidelines presently exist for Steller sea lions.

The National Marine Fisheries Service has implemented several management measures aimed at the protection of Steller sea lions. Coincident with the Endangered Species Act listing in 1990, the National Marine Fisheries Service:

1. prohibited entry within 3 nautical miles of listed Steller sea lion rookeries west of 150º W. longitude;
2. prohibited shooting at or near Steller sea lions; and
3. reduced the allowable take of Steller sea lions incidental to commercial fisheries in Alaskan waters (50 CFR 227.12) (Fritz, Ferrero, and Berg, 1995).

In 1991, 1992, and 1993, the National Marine Fisheries Service implemented additional protective measures to reduce effects of specific commercial groundfish fisheries on Steller sea lion foraging (50 CFR 679.20(a)(5)(ii), 679.22(a)(7) and (a)(8), and 679.22(b)(2) (1994). Since 1998, additional Alaska groundfish fishery management actions have been implemented. In October 2001, following ESA Section 7 consultations to evaluate the impacts of various fishery management plans and related actions, the National Marine Fisheries Service published a final biological opinion and incidental take statement (National Marine Fisheries Service, 2001b). Current Gulf of Alaska and Bering Sea Protection Area closures and restrictions are summarized by the National Marine Fisheries Service (2001b). Corrections to the regulatory text were recently published (68 *FR* 24615).

The National Marine Fisheries Service has issued multiple biological opinions regarding the potential for authorization of various fisheries to jeopardize the continued existence of Steller sea lions or to result in the destruction or adverse modification of their habitat (see National Marine Fisheries Service, 2001b:8-9). In October 2001, the National Marine Fisheries Service released a Final Biological Opinion that evaluated the impacts of fishery management plans, parallel state fisheries, and Steller sea lion conservation measures in the Bering Sea, Aleutian Islands, Gulf of Alaska, and in adjacent waters on Steller sea lions and designated critical habitat.

III.B.4.b(8)(e) Historic and Current Population Distribution, Abundance and Trends

The overall range of the Steller sea lion extends from California to northern Japan (Loughlin, Rugh, and Fiscus, 1984), into the Bering Sea, and along the eastern shore of the Kamchatka Peninsula. The geographic center of their distribution is considered to be the Aleutian Islands and the Gulf of Alaska (Kenyon and Rice, 1961). The center of abundance for the species is considered to extend from Kenai to Kiska Island (National Marine Fisheries Service, 2001b). The breeding range of this species includes most of the North Pacific Rim from approximately 34°-60° N. latitude (National Marine Fisheries Service, 2001b) throughout which there are hundreds of Steller sea lion rookeries and haulouts.

Steller sea lion habitat includes terrestrial sites for breeding and pupping (rookeries), resting (haulouts), and marine foraging areas. Nearly all rookeries are at sites inaccessible to terrestrial predators on remote rocks, islands, and reefs. Locations of Steller sea lion rookery sites in Alaska are presented in the National Marine Fisheries Service (2001b) and in this EIS on Table III.B-5. During the nonbreeding season, sea lions of all ages and sexes aggregate at haulouts, but distribution at rookeries is segregated by sex and territorial status. Locations of Steller sea lion haulout sites in Alaska are presented in the National Marine Fisheries Service (2001b) and in this EIS on Table III.B-6. Available evidence indicates that females return to the same rookery at which they were born to mate and give birth (Calkins and Pitcher, 1982; Loughlin, Rugh, and Fiscus, 1984).

At sea, Steller sea lions generally are found within the continental shelf area; they also inhabit pelagic regions (Fiscus et al., 1976; Merrick and Loughlin, 1997). At sea, adult males usually are observed alone, whereas females of all ages and subadult males comprise most large groups. Adult males are thought generally to disperse widely during the nonbreeding season. After weaning, juveniles are thought to disperse widely. Pups marked near Kodiak have been sighted about 1,700 kilometers away in British Columbia, Canada. Juveniles disperse more widely than adults until about 4 years of age. They do not return to the breeding site until they are close to reproductive age (Calkins and Pitcher, 1982).

Historic estimates of Steller sea lion abundance are crude and not well documented. Kenyon and Rice (1961) estimated the total North Pacific population of Steller sea lions to be about 240,000-300,000. Loughlin (1998:91) stated: "There were reportedly over 300,000 Steller sea lions in the world in the late 1970s. Since then, the Alaskan sea lion population has plummeted to a small fraction of earlier levels…." Loughlin also said: "Historically, the Gulf of Alaska and Aleutian Islands contained the largest fraction (74% in 1977) of the world population, but by 1989 it dropped to 56%" (Loughlin, 1998:93).

In the 2001 stock assessment for the eastern U.S. stock, the National Marine Fisheries Service reported that the most recent estimate of abundance for this stock is based on comprehensive aerial surveys in the summer of 1996. They reported that the minimum population estimate for this stock is 31,005, with 15,173 estimated for Southeast Alaska, 6,555 for Washington/Oregon/California combined and 9,277 for Canada. Based on Figure 4 in the 2001 stock assessment, counts of adult and juvenile Steller sea lions at rookery and haulout trend sites have increased overall in this stock in the period between 1982 and 1998. Counts of non-pups at trend sites in Southeast Alaska increased by 28% from 1979-1996. From 1979-1997, counts of pups at Southeast Alaska rookeries increased about 5.9% annually (Angliss, DeMaster, and Lopez, 2001). Angliss, DeMaster, and Lopez (2001) reported that while this stock has increased in recent years, its status relative to its Optimum Sustainable population size is not known.

In the 1960's, the western population stock was believed to number about 177,000 (excluding pups) and to comprise about 92% of the total U.S population. A population decline in Steller sea lions was first documented in the mid-1970's in the eastern Aleutian Islands. Braham, Everitt, and Rugh (1980) reported that sea lions in the eastern Aleutian Islands declined by about 50% as the population went from approximately 50,000 sea lions to 25,000 between the 1960's and late 1970's. In the late 1970's and early 1980's, dramatic and continuing declines began to be apparent in the central Aleutian Islands and eastward to the western Gulf of Alaska (Merrick, Loughlin, and Calkins, 1987). After a range-wide survey in 1989, it was apparent that the only areas that had remained stable were southeastern Alaska and British Columbia. Based on annual surveys that are now conducted, it is apparent that the decline in the western population has continued, but at a slower rate (Loughlin, 1998). Based on published correction factors, Loughlin and York (2001) estimated the western population has declined at an estimated rate of 5% in recent years and a current population size at 33,000 animals (see Figure III.B-4). Based on the current rate of decline, Loughlin and York (2001) estimated the western population would decline to 11,430 animals by 2020. Counts of adult and juvenile (nonpups) Steller sea lions at rookery and haulout trend sites is presented in the National Marine Fisheries Serve (2001b) and in this EIS on Table III.B-7.

III.B.4.b(8)(f) Foraging Ecology and Prey

Results from unpublished studies by Loughlin et al. (cited in National Marine Fisheries Service, 2001b) of Steller sea lion foraging within the Gulf of Alaska-Aleutian Islands and Washington State from 1994-2000 using satellite dive recorders showed that 93.8% of all locations from prebreeding and breeding-aged animals were within the 0- to 10-nautical mile zone, indicating that this zone is the most important habitat for Steller sea lion foraging (National Marine Fisheries Service, 2001b).

In the Gulf of Alaska and the Bering Sea regions, data indicate sea lions prey on a variety of schooling fishes, including pollock, Pacific cod, Atka mackerel, sculpin, capelin, Pacific sand lance, rockfish, Pacific herring, and salmon. Prey also includes cephalopods such as octopus and squid (Calkins and Goodwin, 1988; Merrick and Calkins, 1996). The relative percentage of different species in the diet differs throughout the range. In the Gulf of Alaska, Merrick and Loughlin (1997) characterized sea lion diet as approximately 66.5% gadoids (pollock, Pacific cod, Pacific hake, and unidentified gadoids); 20.3% Pacific salmon; 6.1 % small schooling fish; 3.9 % flatfish; 2.9 % squid or octopus; and 0.3 % Atka mackerel. In the region of particular relevance to the Proposed Action in Cook Inlet (the central Gulf of Alaska), pollock represents more than 60% of the diet. In the western Gulf of Alaska and eastern Aleutian Islands, this percentage drops to 29% but then rises to about 35% in parts of the central Aleutians (Merrick and Calkins, 1996). Sinclair and Zeppelin (submitted, cited in the National Marine Fisheries Service, 2001b) found that walleye pollock and Atka mackerel were the dominant prey species found in the scats collected during both summer and winter across the range of the western stock of Steller sea lions.

Diving abilities may affect the prey available to yearlings. The maximum depth measured in the winter for a yearling was 72 meters, whereas maximum depths recorded for adult females in winter is greater than 250 meters. In the summer, maximum depths recorded for individual females ranged from 100-250 meters (Merrick and Loughlin, 1997; Swain and Calkins, 1997). Small pollock (less than 20 centimeters in length) are more common in the diet of juvenile sea lions than in that of adults (Merrick and Calkins, 1996). The size of pollock consumed by adults appears to be nearly in proportion to their abundance, but juveniles prefer smaller pollock (Merrick and Calkins, 1996).

Merrick and Loughlin (1997) showed that sea lions may forage over relatively wide ranges. These authors reported estimated home ranges of 320 square kilometers for adult females in the summer, approximately 47,600 square kilometers for adult females in the winter, and 9,200 square kilometers for yearlings in winter. Adult females varied greatly in their estimated home ranges during the winter.

During the breeding season, males may fast for 1-2 months. The average foraging trip length and trip duration for adult females varies seasonally. When nursing a young pup in the summer, the average trip distance is 17 kilometers; they dive about 4.7 hours per day, and the total trip length is about 18-25 hours.

During the summer, Steller sea lions tend to leave rookeries in the late evening and return more than 24 hours later, near dawn (Withrow, 1982; Merrick, 1995; Swain, 1996). Merrick and Loughlin (1997) found that mature females spent approximately the same amount of time per day actively searching for prey in winter as in summer, but that winter foraging trips were longer, possibly due to greater distance to the prey sources (Trites and Porter, 2002). Trites and Porter (2002) further suggest that foraging effort, as indicated by diving for prey, may be indicative of prey abundance. While females usually still have a dependent pup in the winter, their average trip distance is about 130 kilometers, dives total about 5.3 hours per day, and mean trip duration is about 200 hours (Merrick and Loughlin, 1997). Observations of winter attendance patterns by Trites and Porter (2002) suggested that pups and yearlings (19-21 months of age) make independent and shorter trips away from the haulout while their mothers forage. The trips of yearling sea lions are not as far or as long as those of adult females, with mean trip distances of about 30 kilometers and about 15 hours in duration, of which only about 1.9 hours per day are devoted to diving (USDOC, NOAA, National Marine Fisheries Service, 2001).

In discussing potential effects of fisheries, the National Marine Fisheries Service (2001b) noted that sea lions from rookeries or haulouts adjacent to management areas could be impacted by the Proposed Action (Fishery Action), if prey is reduced within their foraging range.

III.B.4.b(8)(g) Evaluation of Causes of Decline

Loughlin (1998:91) reported: "Possible causes for the decline may include redistribution, changed vital rates, pollution, predation, subsistence use, commercial harvest, disease, natural fluctuation, environmental changes, and commercial fishing. The last two are now considered the most probable links to the decline. Steller sea lions may be affected by commercial fishing directly through incidental catch in nets, by entanglement in derelict debris, by shooting, or indirectly through competition for prey, disturbance, or disruption of prey schools."

The National Marine Fisheries Service (2001b:181) concluded:

> There is general scientific agreement that the decline of the western population of Steller sea lions in the 1990's resulted primarily from declines in the survival of juvenile sea lions and lowered reproductive success in adult females. There is less scientific agreement that both of these problems have a dietary or nutritional component (Merrick et al., 1987, Pitcher, 1998, Rosen et al., 2000a, Alaska Sea Grant, 1993, DeMaster et al., 2001). There is less agreement on whether fishery-induced changes in the forage base…have contributed to and continue to contribute to the decline…(DeMaster et al.. 2001). The National Research Council (1996), based on the best scientific and commercial information available, concluded that the groundfish fisheries managed under the two FMPs may adversely affect Steller sea lions by (a) competing for sea lion prey and (b) affecting the structure of the fish community in ways that reduce the availability of alternative prey.

The National Marine Fisheries Service (2001b:97) concluded:

> After considering all of the commercial fisheries that occur in the action area, especially in areas designated as critical habitat for sea lions, and comparing those fisheries against the various fish species consumed by Steller sea lions, we can conclude that commercial fisheries are likely to reduce the amount of prey…sufficient to reduce the habitat's value to the sea lion population.

Lowe and Fritz (1997) presented evidence of localized depletion of Atka mackerel in the Aleutian Islands, and due to potential impacts on Steller sea lion recovery, the National Marine Fisheries Service and the North Pacific Fisheries Management Council took action to move fishing away from sea lion critical habitat.

The National Marine Fisheries Service (USDOC, NOAA, National Marine Fisheries Service, 2001) identified localized depletion of prey as a potential mechanism by which marine mammals may be disadvantaged by competition with commercial fisheries.

Commercial fisheries can affect Steller sea lions and other predators in commercially harvested species in several ways. Commercial fisheries may compete with fish predators (such as sea lions, fin whales, humpback whales, and avian predators) with prey. Predators may be displaced from areas of high fish abundance due to disturbance from boats and other fishery activity (for example, in the past the use of "spotter planes" during herring seining). Predators can become entangle in fishing gear either during fishing activity or if gear is discarded or lost. Previously, certain fish predators (for example, Steller sea lions) were sometimes shot during the course of fishing operations. Perhaps most important, commercial fishing can cause local depletion of prey, so that species such as Steller sea lions must expend more energy in order to obtain the prey.

Reasonable and Prudent Alternatives for the Gulf of Alaska and the Bering Sea/Aleutian Islands, pollock fisheries are based on concerns that these fisheries could be jeopardizing the recovery of Steller sea lions by the reducing the amount of prey available to them (National Marine Fisheries Service, 2000b).

III.B.4.b(8)(h) Reproductive Biology and Longevity

Males establish territories on rookeries in May before females arrive (Pitcher and Calkins, 1981). Females generally give birth to a single pup; twinning is rare. Females are capable of pupping every year but do not always do so. Pups are born during late May to early July. About 2 weeks after giving birth, females breed, with most mating occurring on land (Pitcher, Calkins, and Pendleton, 1998). Females are known to nurse pups during the day. During the first week after birth, mothers generally stay with their newborn pups and then begin to go to sea on foraging trips. Observations of maternal attendance patterns of sea lions in southeast Alaska (outside the range of the western population stock) by Trites and Porter (2002) indicate weaning occurs in early spring (i.e., April-June). Most, but not all, pups wean before their first birthday, but some females nurse offspring for a year or more.

Data indicate that females become sexually mature between 3 and 8 years of age and may continue to breed into their early 20's. Females may live as long as 30 years (National Marine Fisheries Service, 2001d). Data indicate that males reach sexual maturity at about the same range of ages as do females, but they are not successful at holding a breeding territory until they are at least 9 years of age. Males can remain on their territory for up to 7 years, but most are territorial for no more than 3 years (Gisiner, 1985). Males typically do not live beyond their mid-teens (National Marine Fisheries Service, 2001b).

III.B.4.b(8)(i) Mortality Causes and Patterns

It is believed that the first winter after birth is a critical stage in the life history of Steller sea lions and may be key to understanding the ongoing population decline in most of Alaska (York, 1994; Trites and Larkin, 1996; Merrick and Loughlin, 1997). Young animals have smaller home ranges that mature females (Merrick and Loughlin, 1997), are inexperienced, may not be able to dive as deeply, and/or may simply have to learn how to forage effectively (Trites and Porter, 2002). Thus, they may be more limited in the prey available to them (Merrick and Loughlin, 1997) and susceptible to reductions in prey. It is not known when Steller sea lion pups begin to ingest solid food. However, Trites and Porter (2002) suggest that there is apparently a developmental or nutritional necessity for these pups to remain dependent on their mothers until near the end of their first or second year of life. While Trites and Porter (2002) observed immature animals with prey items on the surface, they were not observed eating the prey. These authors note that captive nursing pups have been observed to capture, kill, but refuse to eat live prey, even when their milk intake was restricted.

III.B.4.b(8)(j) Sea Lion Critical Habitat

Critical habitat for the Steller sea lion was designated on August 27, 1993 (58 *FR* 45269) based on information available at the time about rookery areas, haulouts, and marine areas required by the species for survival in the wild.

Rookeries are areas used by adult males and females for pupping, nursing, and mating during the mating season (late May to early July). Haulouts are used by both males and females of all size classes but generally are not sites where reproduction occurs.

Critical habitat for Steller sea lions is listed in 50 CFR § 226.02. Critical habitat for Steller sea lions includes:

- A terrestrial zone that extends 3,000 feet (0.9 kilometers) landward from the baseline or base point of each major rookery and major haulout.
- An air zone that extends 3,000 feet (0.9 kilometers) above the terrestrial zone, measured vertically from sea level.
- An aquatic zone that extends 3,000 feet (0.9 kilometers) seaward in State- and federally managed waters from the baseline or base point of each major haulout in Alaska that is east of 144º W longitude.
- An aquatic zone that extends 20 nautical miles (37 kilometers) seaward in State- and federally managed waters form the baseline or base point of each major rookery and major haulout in Alaska that is west of 144º W longitude.

All major Steller sea lion rookeries are listed in Table III.B-7 and major haulouts in Table III.B-6, along with associated terrestrial, air, and aquatic zones. According to the National Marine Fisheries Service (2001b), the exact locations listed may be out of date, and they are intending to update the locations as soon as practical. In the most recent Biological Opinion on the effects of the Fisheries Management Plan, the National Marine Fisheries Service (2001b:37) included 19 additional haulouts (in addition to those officially designated) "...as critical habitat for the purposes of this biological opinion…" to allow the Office of Protected Resources to "…make a more accurate determination of jeopardy and adverse modification based on the areas truly important to the western population of Steller sea lions" (see National Marine Fisheries Service, 2001b:38 and Figure 3.3). Two haulouts that were identified in this additional list that are especially pertinent to the proposed sales in Cook Inlet are the haulouts at Cape Douglas, and on Perl Island in the Barren Islands. The haulouts at Kak Island and at Mitrofania also are potentially downstream of a very large spill in Cook Inlet. The National Marine Fisheries Service (2001b:37) stated: "NMFS considers these sites very important for the conservation of the species…the most important reason for adding these sites is the protection necessary close to shore (0-10 nm [nautical miles]) which the consideration of these sites will allow."

The critical habitat for Steller sea lions includes two kinds of marine foraging habitat: (1) areas immediately around rookeries and haulouts and (2) three special aquatic foraging areas where large concentrations of important Steller sea lion prey species occur and where Steller sea lions are known to forage.

Marine areas around rookeries and haulouts were designated (National Marine Fisheries Service, 2001b:35)

> …based on evidence that lactating adult females took only relatively short foraging trips during the summer (20 km [kilometers] or less; Merrick and Loughlin, 1997). These areas were also considered important because young-of-the-year sea lions took relatively short foraging trips in the winter (about 30 km; Merrick and Loughlin, 1997) and are just learning to feed on their own, so the availability of prey in the vicinity of rookeries and haulouts appeared crucial to their transition to feeding themselves.

The three special Steller sea lion foraging areas are the Shelikof Strait Foraging Area, Bogoslof Foraging Area in the Bering Sea shelf, and Sequam Foraging Area. Of these three special foraging areas, only the Shelikof Strait Special Foraging Area is near to the proposed multiple-sales area.

The Shelikof Strait Special Foraging Area portion of Steller sea lion critical habitat consists of the area between the Alaska Peninsula and the Tugidak, Sitkinak, Aiaktilik, Kodiak, Raspberry, Afognak, and Shuyak islands (connected by the shortest lines). It is bounded on the west by a line connecting Cape Kumlik (56º38"/157º26' W. latitude) and the southwestern tip of Tugidak Island (56º24"/154º41' W. latitude) and bounded in the east by a line connecting Cape Douglas (58º51" N. longitude/153º15' W. latitude) and the northernmost tip of Shuyak Island (58º37"' N. longitude/152º22'' W. latitude). Shelikof Strait was identified in 1980 as a site of extensive winter spawning aggregations of pollock and, based on take of Steller sea lions in the pollock fishery, as an important Steller sea lion foraging site (Loughlin and Nelson, 1986; Perez and Loughlin, 1991). However, the National Fish and Wildlife Service (2001b:172) summarized that the three special foraging areas:

> …were never considered to be important based on satellite telemetry…. These areas were known to contain high abundances of prey species known to be important for Steller sea lions, and were therefore designated as critical habitat so that the agency and the public would be aware of their possible importance to the survival and recovery of Steller sea lions. Since the designation of these areas as critical habitat, satellite telemetry information has indicated that these areas may not be extensively used by sea lions, especially pups and juveniles which are the age classes of most concern.

The National Marine Fisheries Service (2001b) reported that Steller sea lion terrestrial critical habitat in Alaska appears to be in good physical condition. However, they express some concern for the take of Steller sea lions at these sites due to disturbance for viewing (for example, tour boats), research, or intentional harassment. They report also that while one of the main concerns in the 1980's was that sea lions were being shot at from boats near rookeries and haulouts, they consider this activity to be rare today.

The National Marine Fisheries Service (2001b) recently concluded that prey resources are the most important feature of marine critical habitat for Steller sea lions. They state that the at-sea distribution of the animals is critical to understanding impacts of fisheries on sea lions and their critical habitat. For the purposes of our evaluation, we assume that the same is true regarding evaluating the effects of the proposed multiple sales in Cook Inlet on Steller sea lions and their critical habitat. Recent information about at-sea distribution available from the National Marine Fisheries Service (2001b) and unpublished reports available from their research (Loughlin et al., unpublished, cited in National Marine Fisheries Service 2001b) is summarized in the previous section.

The areas of critical habitat from 0-3 nautical miles and from 3-10 nautical miles from shore are considered to be some of the areas of the highest concern. This is because roughly 95% of the observations of at-sea observations of pups in winter were in the zones from 0-10 nautical miles, and winter is considered to be the most crucial period for pups and juveniles. The area 10-20 nautical miles from shore is considered to be of low to moderate concern for foraging Steller sea lions (National Marine Fisheries Service, 2001b). The zone beyond 20 nautical miles from shore is considered to be of low concern for foraging sea lions. Available information indicates that sea lions foraging in these areas are presumed to be older juveniles and adults that are likely to have advanced diving and foraging ability. The National Marine Fisheries Service (2001b) assumes that these classes of animals would be able to find prey even if there was local extraction competition or interaction. The spatial dispersion zone (beyond 10 nautical miles from shore) also is considered an area of low concern for foraging sea lions, primarily because only 1.9% of the observations of at-sea observations of pups in winter were beyond 10 nautical miles (National Marine Fisheries Service, 2001b).

III.B.4.b(9) Sea Otters (*Enhydra lutris*) (Southwest Alaska Distinct Population Segment of the Northern Sea otter) – Candidate

III.B.4.b(9)(a) Summary

Sea otters are marine mammals that have unique adaptations for survival in the marine environment. They inhabit nearshore coastal areas in many parts of Southcentral and southwestern Alaska. Sea otters from two designated stocks, the southwestern Alaska stock and the Southcentral Alaska stock, are year-round residents in different areas near or “downstream” of the Cook Inlet multiple-sales area, including nearshore areas in parts of western and eastern lower Cook Inlet and associated bays, the Kodiak Archipelago, the Kenai Peninsula, and the Alaska Peninsula. Following the near extinction of this species worldwide due to commercial hunting between the 1870’s and the early 1900’s, sea otters increased and recolonized much of their range in southwestern Alaska. The Aleutian Islands and the Alaska Peninsula were considered strongholds of sea otters in Alaska. The Fish and Wildlife Service has concluded that the designated Southwest Stock of sea otters (extending from the western tip of the Aleutian Islands through the Alaska Peninsula and the Kodiak Archipelago and extending along the western shore of Cook Inlet) recently have declined unexpectedly, significantly, and in some cases, precipitously, over a large portion of their range, due to undetermined causes (65 *FR* 67344). This portion of the range represents a very large part of the total range of sea otters in Alaska and of the extant range of sea otters worldwide. Federal biologists have concluded that increased mortality is likely to be the reason for the decline, but data other than survey data are lacking for most of range. The Fish and Wildlife Service has designated the Southwest Alaska Distinct Population Segment of the northern sea otter as a candidate species for listing under the ESA. The southwest Alaska Distinct Population Segment of the northern sea otter may be formally proposed for listing under the ESA within the 2003 calendar year.

Sea otters are a keystone species in many nearshore ecological communities in the North Pacific. Changes in the structure and composition of nearshore ecological communities in the Aleutians already have been detected following the decline of sea otters in specific and studied areas. Estes et al. (1998) concluded that in the Aleutians, the decline of sea otters is accompanied by a collapse of the nearshore ecosystems of which they are a part, and that their decline may be caused, at least in part, by the collapse of oceanic ecosystems.

In the following, we provide considerable detail about the biology and status of the southwestern and Southcentral Alaska stocks of sea otters. We provide such detail for several reasons. First, otters are year-round residents in areas adjacent and/or “downstream” of the Cook Inlet Planning Area, and they are resident within portions of Cook Inlet. Second, in comments provided March 20, 2002, on the draft EIS for the OCS Oil and Gas Leasing Program: 2002-2007, the Fish and Wildlife Service (USDOI, Fish and Wildlife Service, 2002a:8) recommended that “…the potential impacts to sea otters by the proposed lease sales in the Cook Inlet Planning Area be more fully analyzed and disclosed…” in this and other OCS oil and gas leasing-related documents. Third, it is well-documented that sea otters can suffer both serious acute (for example, Garrott, Eberhardt, and Burn, 1993) and chronic (for example, Rotterman and Monnett,

2002) effects from marine oil spills. Fourth, there is a relatively large amount of information about this putative population stock. However, unlike the situation for some other species, such as Steller sea lions and the Cook Inlet stock of beluga whales, for which there are recent comprehensive syntheses and critical evaluation of existing information available in recent biological opinions, other environmental impact statements and, in some cases, Administrative Law Judge hearings or recovery plans, much of the available information for sea otters has not been recently synthesized, critically evaluated, or reviewed by either the scientific, stakeholder or other relevant communities. Thus, as possible, we needed to undertake such synthesis and critical evaluation to provide an underlying basis for our analyses. We provide this information in the EIS to make our evaluation as transparent as possible and to allow readers to have the same basis for critical evaluation of these analyses and our conclusions. For specific types of additional information, we refer readers to reviews in Kenyon (1969), Rotterman and Simon-Jackson (1988), Riedman and Estes (1990), candidate listing documents (65 *FR* 67343), recent stock assessments (USDOI, Fish and Wildlife Service, 2002b), and references cited in the following section. Details on the abundance and distribution of the Southcentral Alaska stock are presented in the section on nonendangered marine mammals.

III.B.4.b(9)(b) General Description, Morphology, and Physiology

Sea otters, the only living representative of the genus *Enhydra,* exhibit specific adaptations for living in marine environments, some of which are important to evaluating potential effects on them from the Proposed Action. These include, but are not limited to (a) reliance on extremely dense, waterproof fur (see the following) for protection against the cold; (b) a relatively high metabolism for generating heat; (c) crushing cheek teeth for feeding on hard-shelled invertebrate prey; (d) morphological modifications related to aquatic movement (for example, loss of the clavicle, a horizontally flattened tail, and flattened and flipperlike hind-limb modification) (Taylor, 1914; Kenyon, 1969) that make them relatively awkward on land, but commit them to spending large amounts of their time in the water; (e) high fat content of milk; (f) typically, the birth of a single pup; and (g) the ability to give birth in the water (see discussion in Kenyon, 1969; Rotterman and Simon-Jackson, 1988; and Riedman and Estes, 1990).

Within a given population and cohort, adult sea otters are slightly sexually dimorphic in size (Kenyon, 1969; Rotterman and Simon-Jackson, 1988; Riedman and Estes, 1990) and other aspects of morphology. The sex of individuals can sometimes be identified in field by experienced observers. The weights of adult males typically range between 27 and 39 kilograms and those of adult females between 18 and 25 kilograms (Garshelis, 1987). Mean total body lengths and weights have been shown to vary, sometimes significantly, among populations (Kenyon, 1969; K. Schneider, cited in Rotterman and Simon-Jackson, 1988; Monson et al., 2000) and over time in the same population (Rotterman and Monnett, 2002), possibly as a result of differences in prey quality and quantity, poor nutritional status and/or health, or both (Rotterman and Monnett, 2002). Comparison of weights and lengths from different studies must be done cautiously, as data are not always directly comparable.

III.B.4.b(9)(c) Pelage and Physiology

Sea otters have little subcutaneous fat relative to other marine mammals (Kenyon 1969; Rotterman and Simon-Jackson, 1988). Their fur is critical to maintaining body temperature. The pelage is comprised of a very dense woolly underfur and a sparse outer layer of guard hairs (Kenyon, 1969; Tarasoff, 1974). Their pelage appears to allow them to tolerate severe cold (Schneider and Faro, 1975:98). Air trapped between fur fibers insulates and waterproofs the otter from its surroundings and provides buoyancy (Kenyon, 1969; Tarasoff, 1974; Costa and Kooyman, 1982). Maintenance of these properties of the fur requires regular grooming. This reliance on their fur for protection from the cold makes them highly vulnerable to oil contamination of that fur and increases their likelihood of ingesting oil when they attempt to clean soiled fur.

Because they lack substantial subcutaneous fat but inhabit cold-water oceans, sea otters have a high basal metabolic rate to maintain homeostasis (Morrison, Rosenmann, and Estes, 1974; Costa and Kooyman, 1982). Their rate of heat production is estimated to be 2.4-3.2 times higher than that of similarly sized terrestrial mammals (Costa and Kooyman, 1982, 1984). Studies of captive animals suggest sea otters need to consume 20-25% of their body weight in food per day to fuel this high level of heat production (Costa, 1982), whereas the requirements of free-ranging individuals may be even higher (Kenyon, 1969; Costa 1978, 1982). However, typical caloric intakes are unknown.

III.B.4.b(9)(d) Subspecies Designations

There currently are three subspecies of sea otters recognized by the Fish and Wildlife Service (USDOI, Fish and Wildlife Service, 1995a) with nomenclature and ranges apparently based on Wilson et al.'s (1991) univariate and multivariate analyses of 20 skull characteristics. The names and ranges of the subspecies (as proposed by Wilson et al., 1991) are:

- *Enhydra lutris lutris*: current distribution is the Kuril Islands north to the Kamchatka Peninsula and on the Commander Islands, but historically ranged as far south as Japan.
- *E. l. kenyoni*: "Throughout the Aleutian Islands, originally as far north as the Pribilof Islands and in the eastern Pacific Ocean along the Alaskan Peninsula south along the coast to Oregon" (Wilson et al., 1996:33).
- *E. l. nereis*: along the California coast and off San Nicholas Islands. "Formerly extended as far south as Morro Hermos, Baja California, Mexico…" (Wilson et al. (1996:34).

While conclusions about population and subspecies boundaries and distinctions have varied among studies examining different samples and employing different methodologies (for example, Davis and Lidicker, 1975; Hall, 1981; Kenyon, 1982; Roest, 1973, 1976, 1979; Rotterman, 1992; Scheffer and Wilke, 1950; Wilson et al., 1991) (see Table 1 and review in Rotterman, 1992, and reviews in Anderson et al., 1996; Wilson et al., 1991), the Fish and Wildlife Service has long recognized three subspecies with the boundaries differing only slightly from those currently recognized (USDOI, Fish and Wildlife Service, 1979, 1995a; 45 *FR* 33768-33781).

III.B.4.b(9)(e) Population Structure and Designated Population Stocks

There is not agreement among sea otter researchers on the number of sea otter populations within Alaska, but there is now agreement that multiple populations exist. The existence of multiple populations of sea otters in Alaska has been recognized by some workers (Rotterman, 1992) since at least 1985, based on studies of sea otter genetics and ecology. Scientific information based on geographic distribution, movement patterns (for example, Monnett and Rotterman, 1989a,b; 1992b), historical patterns of distribution, current patterns of genetic variability (for example, Rotterman, 1992, Cronin et al., 1996), distribution, abundance and population growth (Gorbics and Bodkin, 2001) consistently has indicated that all sea otters in Alaska are not functioning as a single biological population (Rotterman, 1992). Cronin et al. (1996:550) wrote: "Considerable population structure was apparent from distribution of haplotypes…."

While until very recently the Fish and Wildlife Service classified all sea otters in Alaska as a single population stock under the Marine Mammal Protection Act (USDOI, Fish and Wildlife Service, 1995a, 65 FR 67343), they have now concluded that "…the best scientific information indicates that multiple stocks of sea otters exist in Alaska" (see also 66 *FR* 55693). In 1998, the Fish and Wildlife Service published a draft revision of the 1995 stock assessment, in which three provisional Alaska sea otter stocks were identified: (1) a southwestern Alaska stock, located from the west side of Cook Inlet through the Kodiak Archipelago, the Alaska Peninsula and the Aleutian Islands; (2) a Southcentral stock from Cape Yakataga to Cape Douglas including Prince William Sound and the coast of the Kenai Peninsula; and (3) a southeastern stock; extending from Dixon Entrance to Cape Yakataga (Marine Mammal Commission, 1999). In 1998, The Alaska Sea Otter and Steller Sea Lion Commission objected to the Fish and Wildlife Service's delineation of three separate stocks of sea otters in Alaska (Marine Mammal Commission, 1999), citing deficient underlying science. The Fish and Wildlife Service postponed recognition of multiple stocks. The Fish and Wildlife Service and Alaska Native groups entered into a memorandum of agreement to identify and obtain peer review on the best scientific information concerning the differentiation of the stocks (Marine Mammal Commission, 2000).

In the candidate listing designation in 2000 (65 *FR* 67343), the Fish and Wildlife Service concluded that sea otters to the west of Unimak Pass in the rest of the Aleutians are differentiated from sea otters at points farther east "…by physical oceanography and habitat." However, only one population stock in Alaska was recognized in the candidate listing. With the issuance in 2002 of stock assessments for three population stocks, with the aforementioned boundaries as proposed in 1998, the Fish and Wildlife Service now recognizes that there are multiple populations of sea otters in Alaska. However, when they recognized multiple stocks, the Fish and Wildlife Service included sea otters on both sides of Unimak Pass in the southwestern Alaska stock of sea otters.

There is still not agreement about the exact number of populations and their boundaries. Based on evaluation of patterns of allozyme variability (which provide information about whether interbreeding is occurring, because most of the proteins evaluated are known to be translated from segments of nuclear, rather than mitochondrial, DNA) at 41 loci in a total of 208 sea otters, and evaluating genetic structure within and among the sea otters residing at four locations (each representing distinct remnant population groups that persisted following intense commercial hunting between 1742 and 1911, Rotterman (1992) concluded:

> The four groups of sea otters examined in this study, from the coastal waters of central California, the Kodiak Archipelago, the False Pass area, and Prince William Sound, are currently functioning as distinct biological populations. Thus, they should be managed as separate population stocks and considered separately for inclusion or exclusion under both the Marine Mammal Protection Act and the Endangered Species Act.

Rotterman (1992) concluded that each group studied "…has distinctive genetic characteristics and, thus will be referred to…as populations. It is clear that if there is currently any genetic contact between these three populations, it has not been sufficient to blur the genetic distinctions existing among them."

Rotterman (1992) concluded that data on the movements of radio-instrumented otters studied at various locations within Alaska (for example, Garshelis, Johnson, and Garshelis, 1984; Monnett, 1988; Monnett and Rotterman, 1989a, 1992b) also support the idea that sea otters within Alaska are not functioning as a single population stock, that it is not consistent with the best available data to conclude or to imply that sea otters from the Aleutians are part of the same interbreeding population as sea otters from distant locations, such as the Kodiak Archipelago, or Prince William Sound and, thus, that animals from these locations are not likely to interbreed when mature. While sea otters are capable of long movements, wide stretches of open, deepwater act as barriers to movement (see the previous discussion on movements) (Kenyon, 1969).

Data from restriction fragment analyses of sea otter mitochondrial DNA support the separation of sea otters in Prince William Sound from sea otters farther west, but the investigators did not conclude that Kodiak otters were distinct from those in the Aleutians (Cronin et al., 1996). Based on evaluation of genotypic, phenotypic, distributional data, and population response data (Gorbics and Bodkin, 2001) proposed that there were three population stocks of sea otters in Alaska. Current stock designations are based on the recommendations in Gorbics and Bodkin (2001).

Data indicate that it is likely there was subdivision of populations within Alaska even prior to commercial exploitation (Rotterman, 1992; Cronin et al., 1996). Based on what is known of sea otter natal dispersal patterns (Monnett, 1988; Monnett and Rotterman, 1988), and movements of adult sea otters (for example, Monnett, 1988, Monnett and Rotterman, 1989a, Siniff and Ralls, 1991), it is likely that, even prior to exploitation, sea otters were structured into multiple population stocks in Alaska. Rotterman (1992) concluded that "…information from tagging and telemetry studies indicate that the size of the area in which sea otters function as a regular interbreeding unit is considerably smaller than the distances between the population sampled…" (See Monnett, 1988 for information on dispersal distances and Rotterman, 1992 for further discussion.) Such genetic differentiation among mammalian species that are potentially highly mobile is not uncommon (see references cited in Rotterman, 1992).

The results of Cronin et al. (1996:553) also are consistent with such preexploitation differentiation, at least between Prince William Sound and other locations to the west: "…frequencies of haplotypes are distinct enough between California, Prince William Sound, the Kodiak-Adak-Amchitka-Attu-Medny Islands, and the Kuril Islands to suggest these four groups were somewhat different before exploitation by humans."

III.B.4.b(9)(f) Current Listing Status and Protective Legislation

In August 2000, the Fish and Wildlife Service designated the northern sea otter in the Aleutian Islands west of Unimak Pass as a candidate for listing under the ESA (65 *FR* 67343). As previously noted, at the time of candidate designation, the Fish and Wildlife Service recognized all sea otters in Alaska as belonging to a single stock; only sea otters west of Unimak Pass were designated as candidates. In August, 2001, the Fish and Wildlife Service received a petition from the Center for Biological Diversity to list sea otters in Alaska as depleted under the Marine Mammal Protection Act. The Fish and Wildlife Service published a determination that the petition did not present substantial information that the action was warranted. They determined also that the best scientific information indicated that there were multiple stocks of sea otters in Alaska (66 *FR* 55693). On June 13, 2002, the Fish and Wildlife Service (67 *FR* 40657:40665) revised the geographic extent of the candidate designation: "The geographic extent of the candidate designation now includes the Aleutian Islands, Alaska Peninsula coast, and Kodiak Archipelago."

Sea otters in western Cook Inlet are not mentioned in the wording in the June 13, 2002 *Federal Register* document (67 *FR* 40657) describing the geographical area within which sea otters are included in the candidate designation. There is no other document describing the extension of the candidate status. However, the Fish and Wildlife Service considers "…sea otters on the western side of Cook Inlet to be part of the currently designated Candidate Species" (Burn, 2002c, pers. commun.). The Fish and Wildlife Service has "…been using the term "Alaska Peninsula coast" to include those otters north of Cape Douglas on the west side of Cook Inlet" (Burn,2002c, pers. commun.). Based on information indicating declines along the Alaska Peninsula and in the Kodiak Archipelago, the Fish and Wildlife Service is developing a proposed rule to evaluate listing the Southwest Alaska Stock of sea otters under the ESA as threatened or endangered (Burn, 2002a, pers. commun.). All sea otters within the range of the designated Southwest Alaska stock will be included in the proposed rule (Meehan, 2002, pers. commun.). The draft Proposed Rule to list the Southwest Alaska Distinct Population Segment of the northern sea otter specifically includes Kamishak Bay in the verbal description of the geographic range of the Distinct Population Segment (Burn, 2002b, pers. commun.), and this information is reflected in our final EIS.

In the 2002 draft stock assessment of the Southwest Stock, the Fish and Wildlife Service (2002b) stated that due to the candidate status of sea otters in the Aleutian Islands, the Southwest Alaska Stock of sea otters is classified as a strategic stock.

Because the southwest Alaska stock of sea otters currently is not listed as threatened or endangered under the ESA, there is no critical habitat designated for this stock. In the proposed rule to evaluate listing this designated stock as threatened or endangered, the Fish and Wildlife Service expects to discuss characteristics they believe delineate sea otter critical habitat (for example, bathymetry and distance from shore (Burn, 2002a, pers. commun.) but will not be proposing specific critical habitat (Burn, 2002a, pers. commun.). Critical habitat may be proposed during the following fiscal year (Burn, 2002a, pers. commun.).

The group of sea otters inhabiting the coast off California (*E. l. nereis*) currently is listed as a threatened "species" under the ESA (45 *FR* 33768-33781).

III.B.4.b(9)(g) Comanagement

In 1994, an amendment to the Marine Mammal Protection Act included provisions for the development of cooperative agreements between the Fish and Wildlife Service and Alaska Native organizations to conserve marine mammals and provide for the comanagement of subsistence use by Alaska Natives. Section 119 of the Marine Mammal Protection Act amendments authorized the appropriation of funds to the Secretary of the Interior and the Secretary of Commerce to implement comanagement activities in Alaska (16 U.S.C. § 1388). The Fish and Wildlife Service, Indigenous People's Council for Marine Mammals, U.S. Geological Survey, Biological Resource Division, and the National Marine Fisheries Service developed a Memorandum of Agreement to guide the use of such comanagement funds. To facilitate sea otter comanagement activities, the Fish and Wildlife Service entered into cooperative agreements with the Alaska Sea Otter Commission [since 1998 called the Alaska Sea Otter and Steller Sea Lion Commission (Jack, 2000)], which funded various comanagement activities.

III.B.4.b(9)(h) Historical and Recent Distribution and Abundance

In the following, we present information about general patterns of distribution and abundance of sea otters in Alaska and specific information about the distribution and abundance of the designated southwest stock of sea otters from Cook Inlet west to the end of the Aleutians. For the purposes of assessing the effects of proposed Federal actions in Cook Inlet, the following points are important. First, the Fish and Wildlife Service has concluded that the abundance of sea otters, *Enhydra lutris kenyoni,* in the Aleutian Islands, the

Alaska Peninsula, and the Kodiak Archipelago has declined significantly in the past 10-15 years (Estes et al., 1998; USDOI, Fish and Wildlife Service, 2000a,b,c; 66 *FR* 55693). The Fish and Wildlife Service reported that the trend of the Southcentral Alaska stock is generally upwards (USDOI, Fish and Wildlife Service, 2002b) and that the southeast stock is growing (66 *FR* 55693). While there has been speculation as to the cause of the decline in southwest Alaska, existing data are insufficient to identify which factor(s) is (are) contributing to the decline. Further information is provided in the following and elsewhere (for example, Kenyon, 1969; Rotterman and Simon-Jackson, 1988; Riedman and Estes, 1990; USDOI, Fish and Wildlife Service, 1994, 2002b).

Sea otters are limited in their distribution in Alaska and elsewhere by their need for nearby feeding areas. They generally are typified as inhabiting nearshore waters less than 35 meters deep (Garshelis, 1987) and only rarely ranging beyond the 55-meter-depth contour (Kenyon, 1969; Garshelis, 1987). These limits should not be interpreted too strongly, because sea otters clearly can cross much deeper bodies of water and have been documented as diving to depths of 70-97 meters (for example, Schneider and Faro, 1975; Garshelis, 1983). Sea otters inhabiting the shallow waters north of the Alaska Peninsula and Unimak Island often range far offshore (i.e., at least 42 kilometers) in water up to 80 meters in depth and apparently do not come ashore for long periods of time (Schneider and Faro, 1975). Historically, large groups also were found far offshore in areas near the Trinity Islands and in the Fairweather Grounds off of Yakutat (Lensink, 1962).

Sea otters probably are limited in their northeastern expansion to an area southwest of Port Heiden "…by the periodic formation of heavy sea ice" (Schenider and Faro, 1975:91; see also Kenyon, 1969). Sea otters can tolerate some ice (Kenyon, 1969), including periods of severe ice and weather (Schneider and Faro, 1975). When sea ice forms rapidly, surrounding otters with large expanses of ice for long periods of time, significant mortality can occur due to lack of access to open water and, thus, to food (Schneider and Faro, 1975).

III.B.4.b(9)(h)1 Pre-Exploitation Distribution and Abundance and Location of Remnants

Sea otters once inhabited shallow coastal areas of the southern Bering Sea and the northern Pacific Ocean, from (approximately) Morro Hermosa (Ogden, 1941), north along the coast of North America and then west to the Aleutian, Pribilof, Commander Islands, and south to southern Sakhalin and northern Hokkaido (Barabash-Nikiforov, Risketkina, and Shidlovkays, 1947, Barabash-Nikiforov, Marakov, and Nikolaev, 1968; Lensink, 1960, 1962; Kenyon, 1969; Ogden, 1941; Scammon, 1870). Estimates of pre-exploitation worldwide abundance vary and are crude—for example, 100,000-150,000 (Kenyon, 1960) and more than 200,000 (Johnson, 1982).

In 1742, members of the Bering expedition returned to Russia with sea otter pelts (Golder, 1922, cited in Lensink 1962), prompting intensive, long-term, and eventually rangewide commercial hunting that nearly led to the total extermination of the sea otter and its elimination from most of its historic range (Lensink, 1962; Kenyon, 1969; and Rotterman, 1992). Lensink (1962) believed that the early Russian and the American patterns of hunting in coastal waters of Alaska were so thorough, that the number of otters taken from an area in the first intensive hunting interval probably closely approximated the pre-exploitation population size (Rotterman, 1992).

Pre-exploitation abundance in Alaska in general is unknown (66 *FR* 55693). In 1972, Schneider (1978) estimated that one-half or more of the historic range in Alaska was occupied, but that there were 100,000-120,000 sea otters in Alaska. With respect to pre-exploitation abundance in the southwest stock specifically, Lensink (1962:120) concluded: "Harvest records for the Aleutian Islands indicate that the aboriginal population of sea otters in the Andreanof, Delarof, Rat and Near islands was approximately 75,000 animals," a number he considered "a conservative approximation." This estimate apparently does not include the Fox Islands. Whether it includes the islands of the Four Mountains is unclear.

III.B.4.b(9)(h)2) Postexploitation Distribution and Abundance in the Southwest Alaska Stock

By 1911 when sea otters were protected by the North Pacific Fur Seal Convention, a small number of remnant populations (a minimum of 13, probably slightly more) remained, widely scattered throughout the historic range (Kenyon, 1969; Rotterman and Simon-Jackson, 1988:Figure 1). Of the widely accepted 13 remnants, 11 are represented today (Kenyon, 1969). Six of the identified surviving remnant groups were in the current range of the southwest Alaska stock: in the Rat Islands at Amchitka, in the Delarof Islands, on the north side of Unimak Island near False Pass, at Sandman Reefs, in the Shumagin Islands on the south side of the Alaska Peninsula, and in the Kodiak Archipelago. At least one, possibly two, remnants persisted in Southcentral Alaska: in southwestern Prince William Sound (Kenyon, 1969) and possibly in the Controller Bay region (Rotterman, 1992). Lensink (1962:xii) concluded: "in the aggregate" the number of otters persisting in all of the remnants "…may have numbered between 200 and 500 individuals." Other estimates range slightly higher (fewer than 2,000) Kenyon, 1969).

Recovery in most of the Alaskan populations should have begun in the early 1900's. All surviving populations increased substantially in number, and sea otters descended from at least these 11 groups recolonized a substantial part of the historical range (see Kenyon, 1969; Rotterman and Simon-Jackson, 1988; Riedman and Estes, 1990; USDOI, Fish and Wildlife Service, 1995a). Recolonization is still occurring in some areas, including areas (for example, southeast Alaska) in which translocations were used to re-establish sea otters (Rotterman and Simon-Jackson, 1988; Riedman and Estes, 1990; USDOI, Fish and Wildlife Service, 1994, 1995a).

III.B.4.b(9)(h)3) Historic and Recent Data on the Abundance of the Southwest Alaska Stock of Sea Otters

In November, 2001, the Fish and Wildlife Service (66 *FR* 55693) reported that the current best estimate for sea otter abundance in all parts of Alaska is 74,143, with a 95% confidence interval of ±15,739. We provide this estimate to enable better evaluation of population stock estimates.

As summarized in the following, the best available survey data indicate that the abundance of sea otters recently has declined rapidly and substantially in all island groups throughout the Aleutian Islands west of Unimak Pass (Evans, Burn, and DeGange, 1997; Estes et al., 1998; USDOI, Fish and Wildlife Service, 2002b) and also has declined substantially along the Southern Alaska Peninsula. Substantial but less dramatic declines in detected abundance also are apparent in data from areas along the north side of the Alaska Peninsula and in the Kodiak Archipelago (see Table III.B-13). Available data indicate that the decline likely began earlier in some areas than in others. Apparently referring to the range of the designated southwest Alaska stock in general, the Fish and Wildlife Service (67 *FR* 40657:40665) reported: "Recent aerial surveys document drastic population declines (up to 90% have occurred throughout this area during the past 10-15 years."

III.B.4.b(9)(h)3)a) Aleutian Islands

Evans, Burn and DeGange (1997) state that the most relevant comparisons of data on abundance in the Aleutian Islands are of aerial surveys conducted by Kenyon (1969) in 1965 and by the Fish and Wildlife Service in 1992. In 2000, the Fish and Wildlife Service repeated the 1992 surveys.

III.B.4.b(9)(h)3)a)1 1992 Versus 1965 Distribution and Abundance Data

Counts made in 1992 indicated a varied pattern of change throughout the area of the Aleutians west of Unimak Pass. Evans, Burn and DeGange (1997:10) reported '(A)lthough the total number of otters seen in this survey was similar to that reported by Kenyon in 1965…the distribution has changed."

Substantial declines in numbers between 1965 and 1992 were reported for three out of six island groups for which comparisons were made. The three island groups, the Rat Islands, Delarof Islands, and the Western Andreanof Islands, where the substantial declines in overall abundance were reported, were the three groups containing most of the sea otters in the Aleutians in 1965. Very large increases in abundance were observed for three other island groups (the Near Islands, the Eastern Andreanof Islands, and the Fox Islands), groups for which the entire count ranged from 27-421 otters during the 1965 survey (Kenyon, 1969). Although the trend for the Western Andreanof Islands as a whole was sharply negative (-53.22%

difference), the trend in counts made at individual islands in this group varied substantially. At some of the islands in this group, counts increased by a large amount (with the percent differences ranging from +10 to +414%) whereas at others, they decreased (percent differences ranging from -21.78 to -92.53%). In the Eastern Andreanof Islands, the trend for the island group as a whole was quite positive (+271%), but counts at two out of five islands indicated a negative change (-50 to -64.28%). Total counts for the Andreanof Islands for 1965 and 1992 were 3685 and 3089, respectively.

In the Rat Islands, comparison of 1965 and 1992 data indicated that sea otter abundance had declined substantially at all but one island (the percent differences between the 1965 and the 1992 counts ranged from +5.12 to -75.76%), with the reported percent difference for the island group as a whole being 53.57% (Evans, Burn and DeGange, 1997). However, total estimates for abundance around Amchitka must be interpreted cautiously. Because of strong southwesterly winds and correspondingly "very rough water on the windward side of the island" during surveys (Evans, Burn and DeGange, 1997:8), it is likely that the estimate for sea otter abundance around Amchitka Island in April 1992 is a significant underestimate (1,144 in 1965; 755 in 1992). Evans, Burn and DeGange (1997) report that results from a 1993 ground-based survey suggest the population may be more than double that of the estimate from the aerial surveys. If this suggestion is correct and one replaces the 755 count with a count of 1,510 (= 2 x 755), the total count for the Rat Islands for 1992 would be substantially higher (2,216) and the percent negative difference substantially less (~-29.6%), but still indicative of an overall decline in the island group.

A similar, possibly higher (the percent difference between 1965 and 1992 counts for the island group as a whole being -64.43), pattern of decline was observed in counts from all but one of the Delarof Islands (+25.00 to -77.14% differences reported).

Data in Evans, Burn and DeGange (1997; Table III.B-14) show that a great many more sea otters were counted in 1992 than in 1965 at all islands in the Near and Fox Island groups for which there are comparable data (+3437%). Counts for the Fox Islands increased +3269% between 1965 and 1992. Increases of this magnitude indicate that sea otters were immigrating into these areas. Alternatively, it is possible that large numbers of sea otters were missed during the 1965 surveys, causing underestimate of population abundance at that time.

Kenyon (1969) reported that in sparse populations, few large groups typically are seen. During 1992, only six groups of otters numbering greater than 100 animals were observed throughout the entire range surveyed, and no otters were seen hauled out on land (Evans, Burn and DeGange, 1997:6). Most (58% and 22%, respectively) sea otters were seen in groups of one or two. Evans, Burn and DeGange (1997) observed few (29 individuals in 25 sightings) sea otters during 70 offshore (defined as offshore of 0.9 kilometer) transects, leading them to estimate offshore density as 0.27 otters per kilometer, and the total number of sea otters in the Aleutians in offshore areas as 463 ± 377.

Based on the aforementioned counts, Evans, Burn and DeGange (1997) applied a correction factor (based on simultaneous ground/aerial counts and applied to account for otters missed from aircraft) of 2.38 (SE ± 0.208) to obtain an adjusted population estimate of 19,104 ± 3,272.

III.B.4.b(9)(h)3)a)2) 2000 Versus 1992 Distribution and Abundance Data in the Aleutians

Available data from aerial surveys in 2000 by the Fish and Wildlife Service suggest a substantial decline between 1992 and 2000 of the number of sea otters inhabiting all parts of the Aleutian Islands west of Unimak Pass. In 2000, the Fish and Wildlife Service "replicated" the aerial surveys conducted in 1992, apparently using the same methodology (USDOI, Fish and Wildlife Service, 2000a:2). Detailed description and/or discussion of the 2000 survey conditions, methodology, and results are not available. Doroff et al. (in press, cited in USDOI, Fish and Wildlife Service, 2002b) derived a population estimate of 8,742 (CV = 0.215) sea otters in the Aleutian Islands west of Unimak Pass. As compared to 1992 estimates, current estimates (USDOI, Fish and Wildlife Service 2000a:2) are much lower (-87%) in the Rat Islands, and in the "Central Aleutians" (-71%). Data are not available to compare numbers in 1992 versus 2000 separately for the Delarof, Western Andreanof, or Eastern Andreanof islands. The data show declines in all other areas surveyed (see the following): Near Islands (-62%), Islands of Four Mountains (-28%), and Fox Islands (-58%). Counts from Kenyon (1965 cited in Evans, Burn and DeGange (1997) and USDOI, Fish and Wildlife Service (2000a) are shown in Table 1.

III.B.4.b(9)(h)3)b) Alaska Peninsula

Using north-south strip transects extending from the shoreline to the 70-meter-depth contour, Brueggeman et al. (1988) conducted fixed-wing aerial surveys of sea otters from Unimak Islands to Port Heiden on the north side in the summer of 1986.

Based on a survey in 2000 (USDOI, Fish and Wildlife Service, 2002b) of the same region of the north side of the Alaska Peninsula "…using the same study design, similar aircraft, and experienced observers" (USDOI, Fish and Wildlife Service, 2001) as Brueggeman et al. (1988), the Fish and Wildlife Service derived an abundance estimate of 5,756 (CV = 0.327) of sea otters from Unimak Island to Cape Seniavin (USDOI, Fish and Wildlife Service, 2002b). In a revised stock assessment prepared in August of 2002 but not released until recently, the Fish and Wildlife Service provides an undadjusted estimate of 4,728 for this area, an "adjusted estimate" of 11,253, and a minimum population abundance estimate of 8,535. As the actual data for this survey are not available, nor is documentation of estimation procedures, we cannot evaluate these estimates and simply report them.

Using north-south strip transects extending from the shoreline to the 70-meter-depth contour, Brueggeman et al. (1988) conducted fixed-wing aerial surveys of sea otters on the south side of the Alaska Peninsula from Unimak Island to Pavlof Bay in the summer of 1986. In April of 2001, the Fish and Wildlife Service repeated this survey and derived an abundance estimate of 949 (CV= 0.809) and an adjusted estimate of 2,235 (66 *FR* 55693). In 2001, the Fish and Wildlife Service also surveyed the shoreline of the South Alaska Peninsula from Seal Cape to Cape Douglas and obtained a minimum uncorrected count of 2,190 animals and an adjusted estimate of 5,212 (66 *FR* 55693) (see Map 14). In the revised August 2002 Southwest Alaska stock assessment, Fish and Wildlife Service show an adjusted estimate of 5,212 for this region, with a minimum abundance estimate of 4,845. Again, we cannot evaluate the estimates as there are not sufficient details available to us regarding survey conditions or procedures, estimation assumptions and procedures, etc. Additional shoreline surveys of the Shumagin, Pavlov, and Sanak Islands and of Sandman Reefs resulted in a minimum count of 405 animals. In the revised August 2002 Southwest Alaska stock assessment, Fish and Wildlife Service show an adjusted estimate of 964 for this region with a minimum abundance estimate of 896. At Unimak Island (apparently the south side only), 42 sea otters were observed. In the revised August Southwest Alaska stock assessment, the Fish and Wildlife Service shows an adjusted estimate of 100 for this region with a minimum abundance estimate of 93. Comparison of the 1986 (Brueggeman et al., 1988) and 2000 estimates (USDOI, Fish and Wildlife Service, 2000, unpublished data) for the North Alaska Peninsula indicates a decline of 36-56%. Comparison of the 1986 (Brueggeman et al., 1988) and 2001 estimates (USDOI, Fish and Wildlife Service, unpublished data) for the South Alaska Peninsula indicates a decline of 91-92% (see Table III.B-13). As noted, details regarding these surveys are not available (for example, survey conditions, exact areas flown, etc.), so additional evaluation is not possible.

III.B.4.b(9)(h)3)c) Kodiak Archipelago

In 1989 following the *Exxon Valdez* oil spill, the Fish and Wildlife Service conducted a helicopter survey of the shoreline of the Kodiak Archipelago (DeGange et al., 1995). In both 1994 and 2001, the Fish and Wildlife Service conducted fixed-wing surveys of the Kodiak Archipelago using strip transects to sample areas of high- and low-density sea otter habitat (Bodkin et al., 1999). Comparison of numbers of otters observed in the two surveys indicates a decline in abundance of about 40% from 1994-2001 (see Table III.B-13). During the 2001 surveys, sea otters tended to be more abundant in far north and northwest areas of the archipelago as well as on the southern tip. Few otters were observed on the outside coast (see Map 14). No offshore transects were flown in the Shelikof Strait area (Burn, 2002a, pers. commun.). Thus, there is no information available about offshore abundance or distribution of sea otters in the Shelikof Strait region.

III.B.4.b(9)(h)3)d) Western Cook Inlet

Based on a boat survey of lower Cook Inlet in 1993, Agler et al. (1995) provided an estimate of 5,194 animals (CV = 0.267). This survey probably included sea otters from both the currently designated Southcentral and Southwest stocks. The Fish and Wildlife Service applied a correction factor of 1.43 to account for animals not seen during surveys to derive an adjusted estimate of 8,547 (66 *FR* 55693). The

U.S. Geological Survey, Biological Resource Division conducted aerial surveys of this region in the spring of 2002. Based on these surveys, the Fish and Wildlife Service reported an “adjusted estimate” 6,918 and a minimum population estimate of 5,340 sea otters in Kamishak Bay. As with the other recent surveys, no details of the rationale underlying the estimation procedures were provided. Thus, we cannot evaluate these estimates.

In comments on the draft of this EIS (see Section VII), the Fish and Wildlife Service stated that:

> Our GIS analysis suggests that the geographic overlap between the proposed lease sale area and sea otters from the southwest Alaka DPS is minimal. During this survey, the high-density survey statum covered 3,968 km2 of sea otter habitat adjacent to lower western Cook Inlet from Cape Douglas in the south, northward to latitude 59º58’21”. While approximately 35 percent of this survey stratum…lies within the boundaries of the proposed Cook Inlet lease sale area, few sea otters were observed there. For the entire lower western Cook Inlet survey area, observers recorded 172 sightings with a total of 544 otters, but only a single otter was recorded within the proposed lease sale area. The vast majority of sea otter sightings occurred southwest of Augustine Island. The results of this survey indicate that while considerable numbers of sea otters inhabit the Kamishak Bay area in lower western Cook Inlet, their distribution does not overlap significantly with the proposed lease sale area….

III.B.4.b(9)(i) Minimum Population Estimate and Potential Biological Removal

The Fish and Wildlife Service (2002b) derived a minimum population estimate of 21,518 sea otters for the entire Southwest Alaska stock, with a potential biological removal of 1,076. In the August 2002 version of the stock assessment for the designated Southwest stock, they provide (Table 1 in the stock assessment) an “adjusted estimate” of a total of 41,474 sea otters and a minimum population estimate of 33,203 for the entire designated Southwest Alaska stock.

III.B.4.b(9)(j) Other Indices of Population Status

Other information about population status is available and potentially can provide insight into causes of the decline in abundance in the southwest Alaska stock. Information also is available that can enable fuller evaluation of potential effects of the proposed OCS oil and gas lease sales in Cook Inlet. Information about population status can be obtained from benchmarks (Eberhardt and Siniff, 1977) that indicate the average condition of individuals within the population.

Data available on some such indices, including body condition, survival of pups to the point of independence, dependency periods, and contaminant levels (see Section V.C.5.f – Cumulative Effects), indicate that the population status of sea otters inhabiting at least some locations in the Aleutians is poor relative to other populations of sea otters within Alaska. Current data on such indices are not available for other portions of the southwest Alaska stock. We emphasize that these indices do not point to a cause for poor population status and different causes (for example, poor health or certain contaminants and/or poor food supply) can lead to the same outcome (for example, poor body condition). Data also are available about activity patterns of otters in a few locations. This information on specific population status indices, most of which is available from studies at Amchitka and Adak, supplements data on abundance and distribution and may provide insight into the cause(s) of the decline, at those specific locations.

III.B.4.b(9)(j)1) Condition, Development, and Survival

Monson et al. (2000) compared several indices of population status between sea otters caught in July 1992 and the summer of 1993 at Amchitka (when sea otters there are thought to have been in the early phase of the present decline [Monson et al., 2000]) and from an expanding population of sea otters at Kodiak in the mid-late 1980’s. They concluded that there were differences in several population indices, and that these differences were in response to degrees in resource (apparently prey) limitations between populations (Amchitka versus Kodiak) and between consecutive years (at Amchitka, due to an influx of lumpsuckers that enriched available prey resources in the second year of the study but not in the first) (Monson et al., 2000). Specifically, they reported that:

1. 3- and 4-year-old female sea otters at Amchitka in 1992 (but not 1993) were shorter, had less mass, and lower mass/length ratios (were in poorer condition) than comparable females caught at Kodiak.
2. Dependency periods of pups at Amchitka in 1992 may have been longer (180 ± 5 days) (sample size not given, apparently less than 24) than at Kodiak in the late 1980’s (153 ± 12 days).
3. Pup survival to independence (assuming a 120-day minimum age of independence) was lower (24 per 51 = 47%) at Amchitka versus that at Kodiak (19 per 23 = 83%).
4. At Amchitka, only 2 of 11 pups instrumented in the 2 years were known to be alive the summer following their first winter, suggesting that postweaning mortality may have been high.
5. At Amchitka, the estimated birth rates of 0.37 (CI = 0.21-0.53) for 2- and 3-year-olds to 0.83 (CI = 0.69-0.90) for greater than 4 years old were “nearly identical” to those at Kodiak in the mid- to late 1980’s (a period when that population was expanding rapidly into new habitat).
6. Both reproductive rates and gestation periods at Amchitka were similar to those reported for Prince William Sound and California (Bodkin, Mulcahy, and Lensink, 1993; Jameson and Johnson, 1993, Riedman et al., 1994).

Sample sizes from studies at Adak in 1995 generally are too small to permit meaningful comparison of population indices from that location. Tinker and Estes (1996:Table 1) provide morphologic data collected at Adak in 1995 and qualitatively compare them with data from Monson (1995) from Amchitka in 1992 and 1993. Mean total body lengths of all classes of otters were less at Adak than at Amchitka (Tinker and Estes, 1996). However, small sample sizes (i.e., 16, 4, 3, 6) for the four compared categories precluded meaningful comparison, except for comparisons of nonpregnant females greater than 4 years, where inspection of values indicate that the differences were not significant. Tinker and Estes (1996:4) concluded that “…sea otters at Adak are of similar size and condition to sea otters at Amchitka Island.”

At Adak in the mid-1990’s, mean reproductive rates for all females were 0.94 (n = 17), and 1.25 (n = 12) for females greater than 4 years old (Tinker and Estes, 1996).

The pup survival rates (to a threshold of 120 days) for all females (n = 17) and for females with estimated ages of 4-12 years was 0.53 (n = 17) and 0.60 (n = 15) for females at Adak, respectively, and 0.56 (n = 51) (Tinker and Estes, 1996) at Amchitka (n = 39) for females 4-12 years. However, Amchitka pup survival rates for females 4-12 years, the overall survival rate for the Adak (Tinker and Estes, 1996), and the Kodiak rates are all within the range of pup survival rates reported from Prince William Sound, where rates for six cohorts ranged from 0.53-0.88, with an overall survival rates of 0.67 (n = 141) (Monnett and Rotterman, 2000). Further, as noted previously, the Amchitka pup survival estimate apparently includes the assumption of loss of five pups that apparently were never seen but were assumed to have been born and lost, based on female behavior (Monson et al., 2000:461).

The significance of the Amchitka results regarding postweaning survival cannot be interpreted, because only one carcass was found and searches were made from shore and from boats, rather than aircraft. Monnett (1988) found that most weanlings made a rapid, long-distance move from their weaning site to their postweaning home range. Most weanlings traveled at least 20 kilometers from where they were weaned, with distances ranging up to 120 kilometers. Monnett (1988:16-17) stated: “(B)ecause departures were abrupt and movements were fairly long, contact was usually lost until a search could be made from an aircraft.” Other studies (for example, Garshelis, Johnson, and Garshelis, 1984; Jameson, cited in Riedman, 1987) also reported long distance moves by weanlings.

The estimated mean dependency period for Amchitka Island is high not only compared to the population at Kodiak, but is high also compared to data collected in Prince William Sound from the mid-1980’s to early 1990’s. In that study, the estimated mean dependency period, assuming a minimum weaning age of 90 days, was 167.9 days (S.D. = 32.4, Range = 90-261, N = 81) or assuming a minimum weaning age of 120 days, was 173.05 days (S.D. = 27.6, Range = 123-261, N = 75) (Monnett and Rotterman, 2000). It also is high relative to mean dependency periods reported from some, but not other, studies in California.

III.B.4.b(9)(j)2) Evaluation of Population Status Based on Age Distribution of Recovered Carcasses

Monson et al. (2000:464) concluded that:

> The paucity of fresh carcasses recovered at Amchitka during the late winter/early spring periods of 1993 and 1994, compared with earlier studies at Amchitka…((Kenyon, 1969, Estes, 1977) suggests that starvation-induced mortality was comparatively low during our study.

They argue that "…sea otters at Amchitka had been recently released from food-limitation at the time of our study" Monson et al. (2000:464). Carcass data from Adak in 1995-1996 (Tinker and Estes, 1996) were inadequate (with 15 accurately aged) to evaluate mortality patterns relative to those estimated based on carcass data elsewhere.

III.B.4.b(9)(j)3) Activity Budgets

Eberhardt (1977) proposed that activity budget data might be useful in assessing population status relative to its status if it were at carrying capacity (Garshelis 1987). Generally, one would expect that the time spent foraging would increase as densities approached carrying capacity, due to decreased food supplies and, in some cases, due to intraspecific competition. Numerous studies have attempted to use activity budget data to assess the population status of sea otters in various parts of the range (for example, Estes, Underwood and Karmann, 1984; Estes, Underwood, and Karmann, 1986; Garshelis, Garshelis, and Kimker, 1986; Ralls and Siniff, 1990; Gelatt, 1996). However, comparisons of population status based on such data need to be made cautiously since factors including, but not limited to age, sex, reproductive status, time of day, season, weather, etc. have all been shown to be associated with differences in the activity budgets of sea otters (for example, Garshelis, Garshelis, and Kimker 1986; Gelatt, 1996.

Because a large population of sea otters has resided at Amchitka since at least the 1940's (Lensink, 1962; Kenyon, 1969), some researchers have predicted that activity patterns at Amchitka would typify those of an equilibrium population. Foraging times of different age and sex classes of otters at Amchitka between late 1992 and spring 1994 were similar to those reported for California (Ralls and Siniff, 1990), except that no difference was found at Amchitka between juvenile males and females. The total time spent foraging (21-52%, depending on the sex/age class examine) was less than an estimate (Estes et al., 1982) based on diurnal scans (55%) for otters at Amchitka in 1971 and 1977 (Gelatt 1996). The time spent foraging by adult females and males on Amchitka was less than that observed by Garshelis, Garshelis, and Kimker, (1986) for otters in the long occupied region of Prince William Sound but slightly more than in a recently occupied area in Prince William Sound (Gelatt, 1996).

Comparison of Gelatt's (1996) activity data from Amchitka and similar data collected over the course of a year (1994-1995) (Tinker and Estes, 1996) at Adak showed fairly similar activity budgets (Tinker and Estes, 1996) for different sex/age classes, with the following exceptions: adult males at Adak spent significantly more time foraging than did their counterparts at Amchitka (45.0% ± 1.85 versus 37.5% ± 3.00, respectively), whereas juvenile females at Amchitka spent more time foraging than their counterparts at Adak (49.9 ± 3.16 versus 40.3 ± 2.47, respectively) (Tinker and Estes, 1996:Table 5). Tinker and Estes (1996:21) reported: "On average, sea otters at Adak spent 40.9% (± 11.07) of their time feeding…," which "…is within the range of values expected for sea otter populations at equilibrium (Estes et al., 1982; Estes, Underwood, and Karmann,1986)."

Sea otter activity budgets, including foraging activity, vary among populations and have been proposed (Eberhardt, 1977) as a potential indicator of population status relative to equilibrium, with the prediction that competition for prey and prey search time both increase with population density, resulting in more asynchronous and greater foraging effort in populations at equilibrium versus those at submaximal levels. The results of studies in the Aleutians (Estes et al., 1982; Gelatt, 1996), Prince William Sound, (Garshelis, Garshelis, and Kimker, 1986) and California (Estes, Underwood, and Karmann, 1986; Ralls and Siniff, 1990) aimed at testing these predictions are inconclusive (Gelatt, 1996). Factors that have been found to be associated with the activity of sea otters at various locations include weather conditions (Amchitka: Gelatt, 1996); time of day (Amchitka: Gelatt, 1996); changes in seasons (Amchitka: Gelatt, 1996); female reproductive status (for example, unaccompanied, with very small pup, with large pups, etc.) (Amchitka: Gelatt, 1996); sex/age class (Amchitka: Gelatt, 1996; Adak: Tinker and Estes, 1996).

The demands of pup rearing greatly alter female foraging and other activity patterns (for example, Sandegren, Chu, and Vandervere, 1973; Garshelis and Garshelis, 1987; Ralls and Siniff, 1990), with impacts changing depending on the age of the pup (Gelatt, 1996). Differences detected at different locations are not always consistent, possibly due to population or environmental differences among the areas being compared (Estes, Jameson, and Rhode, 1982). At Amchitka, time-budget differences were observed among unaccompanied females, females with very small pups, females with small pups, and females with large pups. Females may not feed at all during the first day following birth (Hanson et al., 1993; Gelatt, 1996). Females with pups less than 3 weeks of age spent less time foraging, had shorter foraging bouts, and fewer foraging sessions than females with larger pups and than those without pups, and spent considerably more time hauled out (29% versus 3-12% for other classes of females) (Gelatt, 1996).

III.B.4.b(9)(k) Longevity

Average longevity of male and female sea otters in different populations is not well defined, and reported values should be interpreted in light of demonstrated errors in age estimation (for example, see Schneider, 1973; Garshelis, 1984; Bodkin et al., 1997). In the Aleutian Islands, Schneider (1978) rarely found males for whom he estimated (based on cementum layers) ages older than 15 years, but females in this old age grouping were not uncommon. Pietz, Ralls, and Ferm (1988) estimated the maximum ages (estimated from tooth cementum layers) of male and female otters in California to be 15 and 16 years old, respectively. The maximum estimated ages reported for free-ranging female and male sea otters are 23 and 18 years, respectively (Schneider, 1978). Based on data in Bodkin et al. (2000:Figure 4), none of the male and female otters recovered as carcasses after the *Exxon Valdez* oil spill had ages estimated over 17 and 16 years, respectively.

III.B.4.b(9)(l) Social Organization and Territoriality

Within a population, sea otters are spatially segregated by sex (Lensink, 1962; Kenyon, 1969; Schneider, 1978; Garshelis, Johnson, and Garshelis, 1984; Monnett, 1988; Rotterman and Simon-Jackson, 1988; Jameson, 1989), age, and reproductive status (Monnett, 1988), although segregation is not absolute (for example, Garshelis, Johnson, and Garshelis, 1984).

Many nonbreeding males congregate into “male areas” and often raft together when resting (Garshelis, 1983; Monnett and Rotterman, 1989). The frequency of these male areas, and the distance between male areas, differs greatly between locations. At Amchitka, for example, distances between male areas are about 15 kilometers or less (Riedman and Estes, 1990) whereas in Prince William Sound (in the 1980’s), distances were much greater. Male groups contain both subadult and adult males (Monnett, 1988; Jameson, 1989). In Prince William Sound, 97% of the individuals captured in male areas were male, whereas estimates of the percentages of males observed in female areas ranged from 11-33%, depending on season and exact locality (Garshelis, Johnson, and Garshelis, 1984). Thirty percent of the subadult males studied by Jameson (1989) in California were located in such male groups. There were more juvenile females (53) than juvenile males (31) in female areas near Amchitka (Kenyon. 1969), and most of the dead juveniles found at male haulout areas were male (6 females:30 males) (Lensink, 1962).

In areas where recolonization is occurring, male groups sometimes are located near the ends of the range (Peterson and Odemar, 1969; Wild and Ames, 1974; Garshelis, Johnson, and Garshelis, 1984), but this is not always true (for example, see Monnett, 1988). In areas such as Amchitka, male groups sometimes are located in less sheltered areas than those occupied by females, pups, and breeding males (Schneider, 1978). Aggregations in male areas can contain several hundred individuals (for example, Monnett and Rotterman, 1989b). Aggregations of more that 1,000 individuals (sex unspecified) have been observed (Schneider, 1976). Female aggregations, well in excess of 100 individuals, have been observed frequently in Prince William Sound (Monnett, 1988), in coves along the Alaska Peninsula, and in the Bering Sea (Monnett, 1988; Monnett and Rotterman, 1989a), and near Kodiak Island (A. DeGange cited in Monnett, 1988).

At least in some areas within Alaska, females use different areas of their total home range in different seasons and depending on their reproductive status (Monnett, 1988). For example, females with large pups within about a month of weaning often travel to sheltered and relatively shallow areas where they remain relatively sedentary prior to weaning (Monnett, 1988). Certain areas are used as “nursery areas,” where large numbers of females with pups congregate.

Sea otters are polygynous. Breeding males occupy and patrol territories (Schneider, 1971; Garshelis, Johnson, and Garshelis, 1984; Jameson, 1989) within "female" areas that are otherwise occupied predominately by females and their dependent pups, or may more actively search for estrous females (Garshelis, Johnson, and Garshelis, 1984). Females move between male territories (Garshelis, Johnson, and Garshelis, 1984; Kenyon, 1969; Vandevere, 1970).

III.B.4.b(9)(m) Patterns of Breeding and Births Throughout the Year

Observed patterns in the timing of sea otter births, including if and when distinct peaks in the frequency of births exist and the degree of synchronization of pupping, have varied considerably both among populations from different parts of the range, among studies of the same population studied at different times, and even in different locations within a population. The reasons for such variability are unclear (see Monnett and Rotterman, 2000).

Examination of reproductive organs from locations throughout the Aleutian and Shumagin Islands indicated an absence of a distinct breeding season in otters (Sinha, Conaway, and Kenyon., 1966). Based on the frequency of pregnancy observed in addition to reproductive tracts, Kenyon (1969) concluded that available data indicate maximum breeding occurs in late fall to winter. Lensink (1962) concluded that, in Alaska, the peak of breeding tends to be in August or September.

Lensink (1962) concluded that while young can be born in any month, there is a peak of pupping in March or April. In the 1950's and 1960's, data indicated the frequency of births at Amchitka increased in early spring and peaked in the summer (Kenyon, 1969). Based on the sizes of pups collected in the Aleutians between 1967 and 1970 inclusive, Schneider deduced that the mode of pup births occurred in May (Schneider, 1973). At Amchitka between July 1992 and early 1994, both data on the births to marked females and data from surveys of the ratios of pups/independent otters, confirmed that while pups were born throughout the year, there was a distinct peak in births occurring approximately May-June), and that mother-pup separations peaked in October (see Monson et al., 2000:Table 3). At Adak Island, ratios of pups to adults observed in three survey units along the outer coast were fairly constant throughout the year (Tinker and Estes, 1996:6), except for a "Slight increase in the ratio of small pups…in September/October." Within Clam Lagoon, large pup/adult ratios increased during the late spring and peaked in May (Tinker and Estes, 1996:Figure 3). However, because this trend is not preceded by a similar trend in small pup/adult ratios, this increase may simply represent immigration of females with pups into the lagoon beginning in the spring. In both Clam Lagoon and along the outer coast, the ratio of small pups/adults was very low, or zero, in the month July.

A lack of strong seasonality of births was reported for sea otters in the Kodiak Archipelago of Alaska (Monson and DeGange, 1995). In Prince William Sound, Garshelis et al. (1984) reported that most pups in the Green Island area of Prince William Sound were born in May during the period of their study (1980-1981). In the western Pacific, Barabash-Nikiforov, Marakov, and Nikolaev (1968) reported that pupping peaked in May-June, but reported two peak breeding periods: June-July and September-October. These authors reported that severe hunting could cause a lack of mating and pupping peaks. Most studies in California have concluded there is a primary birth peak in late winter and a secondary peak in late summer/early fall in that population (for example, Fisher, 1940; Sandegren, Chu, and Vandervere, 1973; Siniff and Ralls, 1991; Vandevere, 1970). However, Riedman et al. (1994) reported the pattern of births in Monterey Bay was essentially uniformly distributed among months

III.B.4.b(9)(n) Male Reproductive Biology

Male sea otters are estimated to reach sexual maturity at age 5-6 years (Green, 1978; Schneider, 1978). Existing data suggest that breeding males typically are a minimum of 6-7 years old (Schneider, 1978; Garshelis, 1983), with some information suggesting they are more likely to be 8-10 (Johnson, cited in Ralls et al., 1983). All testes and epididymis from adult males from Amchitka examined by Lensink (1962) in the mid-1950's between February and August contained abundant sperm. No sign of senescence was observed in the sperm production of old males (Kenyon, 1969).

III.B.4.b(9)(o) Female Reproductive Biology

IIII.B.4.b(9)(o)1) Reproductive Potential

The reproductive potential of sea otters is relatively low, because usually only one young is born, there is no post-partum estrus, and gestation is long (Sinha, Conaway, and Kenyon, 1966).

III.B.4.b(9)(o)2) Estimates of Age of Sexual Maturity and First Reproduction

Efforts to determine age-related patterns in sea otter reproduction, such as age of first reproduction, and age-specific reproductive rates, of both sexes are hampered by errors in age-estimation based on the number of annuli in sectioned teeth (for example, see Schneider, 1973; Garshelis, 1984; Bodkin et al., 1997). Based on reproductive tracts, Kenyon (1969) and Schneider (1973) estimated age at sexual maturity of females in the Aleutian Islands to be 3-4 years of age. Based on reproductive tract data from carcasses collected in Prince William Sound after the *Exxon Valdez* oil spill and the assignment of females to age categories based on age estimates made by examination of sectioned teeth, Bodkin, Mulcahy, and Lensink (1993) reported the following estimates of the percentages of females that were sexually mature in various age classes: estimated age 2 (the third year of life) (n = 27): 30%; estimated age 3 (n = 11): 73%; estimated age 4 (n = 11): 73%; estimated age 5: 100%. While two of nine (22%) marked, known-aged females in California became sexually mature at age 2 (the third year of life) (Jameson and Johnson, 1993), these authors conclude most females breed for the first time in their fifth year of life. Three of fourteen (21%) females marked as 1- or 2–year olds at Kodiak in the mid-1980's pupped as 2-year olds and 8 out of 14 (57%) pupped by age 3 (Monson and DeGange, 1995). These estimates for Kodiak may be underestimates as multiple, large (for example, several month), but unquantified gaps in monitoring occurred during this study. Of 25 radio-instrumented females observed at Kodiak in the aforementioned study for at least 1 year (resighting interval not reported), 88% of 4-year olds and 100% of 5-year olds were observed with a pup. These age-specific birth rates were "nearly identical" to those at Kodiak in the mid to late 1980's.

III.B.4.b(9)(o)3) Length of Pregnancy and Reproductive Rates

A captive-born sea otter pup born less than 1 month premature was born on the 237th (7.9 month) day of pregnancy (Barabash-Nikiforov, Marakov, and Nikolaev, 1968). Four out of five pregnancies of captive otters were 7-8 months in length (Antrim and Cornell, 1981).

Siniff and Ralls (1991) estimated the mean reproductive rate of sea otters residing off of the California coast in the mid-1980's as 0.90. Tinker and Estes (1996) derive an estimate of 0.94 (n = 17) for the mean reproductive rate of female sea otters with ages estimated between 2-11 years old at Adak Island over a period of approximately a year in the mid-1990's. At Adak, the estimated reproductive rate of females with estimated ages of greater than 4 years was 1.25 (n = 12) (Tinker and Estes, 1996). Monson et al. (2000) reported that birth rates of females at Amchitka increased with age from 0.37 (CI = 0.21-0.53) for 2- and 3-year olds to 0.83 (CI 0.69-0.90) for greater than 4-year olds, but it is unclear how an assumption that five pups were born and lost (but never seen) affects these estimates. Tinker and Estes (1996) characterize their estimated reproductive rate as "quite high" compared to the aforementioned estimate of 0.90 of Siniff and Ralls (1991) and that in Monson (1995) for Adak Island, but they do not compare these rates statistically. It is unlikely that the overall Adak and California reproductive rate estimates are statistically different. Riedman et al. (1994) also report an estimated birth rate of 0.90 per year for all adult females based on a tagging study in California. Jameson and Johnson (1993) conclude that "(A)bout 85-90% of adult females pup in a given year. At Adak, estimated reproductive rates were greater, but pup survival rates lower, for the subsample of instrumented females outside of Clam Lagoon compared with those within (Tinker and Estes, 1996).

Based on evaluation of reproductive organs from the carcasses of sea otters recovered after the *Exxon Valdez* oil spill, Bodkin, Mulcahy, and Lensink (1993) reported that 56% of 115 female sea otters deemed sexually mature were pregnant-implanted, 13% were pregnant-unimplanted, 16% were lactating, and 16% were not pregnant.

III.B.4.b(9)(o)4) Dependency Periods and Timing of Weanings

Comparison of dependency periods among studies must be done cautiously, because methodology and underlying assumptions may differ between studies (Monnett and Rotterman, 2000). Estimated dependency periods reported for individual sea otters are highly variable both within and among studies, ranging from 76 days for a pup in Prince William Sound known to survive following weaning (Monnett 1988; Monnett, Rotterman, and Siniff, 1991; Monnett and Rotterman, 2000) to 333 days, also in Prince William Sound (Monnett, 1988; Monnett et al., 1991; Monnett and Rotterman, 2000), to approximately a year in the Aleutians (Kenyon, 1969). The causes of such variation are not well understood (see Monnett et al., 1991; Monnett and Rotterman, 2000). While there is considerable range within many populations in individual dependency periods, the range of averages (5-6.5 months) found in most, but not all (Wendell, Ames, and Hardy, 1984). Sea otter studies in which marked females were observed are rather small: California: mode = 6.5-7.0 months) (range 5-8 months) (Wendell, Ames, and Hardy, 1984); California: mean = 193.9 days (range 135-289) (Siniff and Ralls, 1991); California 1978-1991: mean = 6.1 months (range 5-7.5 months) (Jameson and Johnson, 1993); California 1985-1991: mean = 166 days (Riedman et al., 1994); Prince William Sound, 1984-1987: 169 days (range 76-333) (Monnett et al., 1991); Prince William Sound, 1987-1991: 167.9days (range 90-261) (90-day minimum dependency assumed) or 173.05 days (123-261) (120-day minimum dependency assumed) (Monnett and Rotterman, 2000); Kodiak 1980's: 153 ± 12 days (Monson and DeGange, 1995). Mean dependency at Amchitka in the early 1990's, when the local population was in the early phases of a decline (Estes et al., 1998) was 180 ± 5 days, a value that Monson et. al. (2000) contrasted with a mean dependency period estimate of 153 ± 12 days for pups residing in the Kodiak Archipelago in the late 1980's (Monson and DeGange, 1995). These authors cautioned that imprecision in the estimates may account for the differences (Monson et. al., 2000) but do not report information needed to evaluate the potential error.

Reported seasonal patterns of mother-pup separations vary greatly throughout the range. At Amchitka between July 1992 and March 1994, mother-pup separations peaked in October (Monson et al., 2000). In Prince William Sound, most mother-pup separations took place between mid-October to mid-November (Monnett, 1988; Monnett et al., 1991). In California, Riedman et al. (1994) reported only a slight seasonal pattern in separation, which was slightly higher from February to August.

III.B.4.b(9)(p) Rates of Survival and Causes of Natural Mortality Throughout the Range

With the exception of a few well-studied locations, there are few data available for most of the extant range to accurately estimate age-specific survival rates, to indicate the causes of mortality of free-ranging sea otters, or to accurately estimate loss associated with specific sources.

III.B.4.b(9)(p)1) Rates of Mortality during Dependency

Estimates of pup survival to the point of independence reported from different studies may not always be directly comparable (Monnett and Rotterman, 2000). However, it is clear from available information that the rate of pup loss in sea otters is highest in the first 1-60 days after birth (summarized in Monnett and Rotterman, 2000; see also data in Siniff and Ralls, 1991; Riedman et al., 1994; Monson and DeGange, 1995; Monnett and Rotterman, 2000; Monson et. al., 2000). At Amchitka, the survival rate of pups may have been related to the mass/length ratios of their mothers and to the season in which they were born (Monson et. al., 2000).

Data on pup survival are available from recent studies in the Rat and the Western Andreanof islands. Based on observations of radio-instrumented and tagged females and on the survival of some pups caught with their mothers, Monson et al. (2000) estimated 47% (24 of 51) of the pups born at Amchitka between July 1992 and March 1994 survived to independence. This estimate includes the assumed loss of "a few" but unspecified number of pups that were never seen but were assumed to have been born and lost due to the behavior of the presumed mother (Monson et al., 2000:459). If incorrect, this assumption would bias the estimate of preweaning survival downward. The estimated rate of survival of pups of mothers with estimated ages of 4-12 years was 0.56. Based on a year-long study at Adak in the mid-1990's, (Tinker and Estes, 1996) estimated the rate of pup survival over all females at Adak was 0.53 (n =17) and was 0.60 for the pups of females 4-12 years of age (n = 15).

Reported estimates of pup survival rates (assuming a 120-day minimum weaning age) from other populations in Alaska are also available: 0.67 (n = 141) for Prince William Sound in the mid-1980's to early 1990's (the range of estimates for different cohorts was 0.53-0.88) (telemetry study) (Monnett and Rotterman, 2000) and 0.83 (n = 23) for Kodiak in the late 1980's (Monson et. al. (2000). Under the same set of assumptions about weaning age, rates of pup survival to independence in California have included 0.30 (n = 10) (telemetry study) (Siniff and Ralls 1991), 0.71 (n = 14) (tagging study) (California Dept. of Fish and Game data in Siniff and Ralls 1991), and 0.66 (n = 136) (tagging study) (Riedman et al. 1994).

III.B.4.b(9)(p)2) Postweaning Survival

None of the six pups instrumented at Amchitka in the summer of 1992 were known to be alive in June 1993, and only two out of five born in 1993 were known to be alive in June 1994. Missing animals were not found during boat searches of the island. One death was confirmed by carcass recovery (Monson et al., 2000). However, because the authors note that "…a high rate of known, premature radio failures compromised the survival analysis…" (Monson et al., 2000:460), these data should be interpreted cautiously. Postweaning survival rates of females (n = 15) in Prince William Sound in the mid-1980's ranged from 0.29-0.38, and those of males (n = 20) from 0.20-0.70, depending on assumptions made in calculations and whether human-caused deaths were included. In total, 14 out of 35 weanlings are known to have died, and contact was lost with an additional 8 out of 35 (Monnett, 1988). Kenyon (1965) noted that more male juveniles are found dead on beaches than are females and that Rausch (1953, cited in Kenyon, 1969) had noted that the "heaviest mortality occurred…in subadult males." Kenyon (1969:260), however, reported that this apparent difference is exaggerated by the fact that "(O)n partially mutilated carcasses, the likelihood that a male might be identified was greater…," because the baculum remains attached to the skeleton for long periods and makes it easier to identify males than to identify females (for which the sex is more likely to be categorized as unknown). In his 3-year (1959, 1962, and 1963) study of carcasses on Amchitka beaches, 58% were male (evaluating only fresh carcasses to avoid the aforementioned bias).

III.B.4.b(9)(p)3) Adult Survival and Estimates from Carcasses

Based on studies of the fates of tagged and/or radio-instrumented otters, Siniff and Ralls (1991) estimated the following survival rates for sea otters residing off the California coast: 0.91 for adult females, 0.67-0.71 for adult males, 0.77-0.85 for juvenile females, and 0.86-0.88 for juvenile males. Minimum and maximum survival estimates for all females (mostly young individuals) at Kodiak Island during the late 1980's were 0.89 and 0.96, and 0.86 and 0.91 for all males (Monson and DeGange, 1995). At Adak in the mid-1990's, only 13 out of 36 instrumented otters outside Clam Lagoon, but 7 out of 9 within Clam Lagoon could be accounted for by the end of the study. During the year of the project, "…an average of 3.54% of the initial sample of tagged otters disappeared each month. This is over twice the rate…" (average of 1.28%) at Amchitka in the early 1990's (Monson 1995, cited in Tinker and Estes 1996). The authors concluded that mortality was elevated over that expected for an equilibrium population.

Information about the estimated age and the sex of recovered carcasses also has been used to infer age and sex-specific patterns of mortality. More males generally are found than females in such samples (for example, Kenyon, 1969). Based on carcasses collected during monthly beach surveys of 3 index areas, spring island-wide surveys and opportunistic collections undertaken at Amchitka in the early 1990's, Monson et al. (2000) used estimated age at death distributions (based on tooth analysis).of 156 carcasses to estimate age-specific mortality. The distribution of estimated ages of the carcasses was as follows: 39% young (less than 2 years), 18% prime (2-8 years), and 43% old (greater than 8 years). As in other studies, mortality was high in the first year of life, "declined abruptly after that and was approximately 5% year^{-1} to age 4," then increased slowly to ~20% year 1 by age 10, and then rose more rapidly after age 11.

At Bering Island between 1983 and the winter of 1990-1991, the proportion of the number of carcasses recovered to the number of live individuals counted during surveys on an annual bases was 0.05 (SE = 0.01) (Bodkin et al., 2000). Of 1,264 carcasses collected from Bering Island during this same period, 25 were juvenile, 34% adult, and 41% aged; the age-class distribution did not differ between sexes, but each year the carcasses were predominantly of males (mean = 0.71, SE = 0.04, range 0.61-0.91). During a period of increased mortality (winter of 1990-1991), the proportion of carcasses collected to the estimated population rose to 0.28, 81% of the carcasses were male, and 75% were classified as adult. Significant differences existed between the sexes in the estimated age-class structure of recovered carcasses, with female age classes being even distributed (Bodkin et al., 2000). For the 3 years following 1991, the mean annual ratio of recovered carcasses to the population count doubled (compared to pre-1991) to 0.10, and carcasses again were predominantly male; juvenile carcasses predominated in the female sample, while adults predominated in the males. The authors concluded: "We speculate that male-biased mortality was the primary mechanism responsible for equilibrating the Bering Island sea otter population with prey resources" (Bodkin et al., 2000:215).

III.B.4.b(9)(p)4) Documented Causes of Natural Mortality in Alaska

Rates associated with various causes of natural mortality of different age and sex classes of sea otters in most of Alaska are not well documented. Causes of natural mortality have been identified from studies at one or more locations in Alaska. These are starvation and/or loss in winter storms (for example, Lensink, 1962; Kenyon, 1969); severe ice formation (Lensink, 1962; Schneider and Faro, 1975); predation by bald eagles (very small pups only) (Sherrod, Estes, and White, 1975; Gelatt, 1996); predation by orcas (*Orcinus orca*) (Hatfield et al., 1998; Estes et al., 1998); disease (for example, Kenyon, 1969; Thomas and Cole, 1996); injury associated with mating or fighting (for example, Garshelis, Johnson, and Garshelis, 1984); and coyote predation (Monnett, 1988; Monnett and Rotterman, 1988; Rotterman and Simon-Jackson, 1988). Thus, available information (e.g., see Rotterman and Simon-Jackson, 1987, Monnett, 1988, Gelatt, 1996, and other references cited above) on causes of mortality in Alaska, does not indicate that shark predation, which has historically been cited as an important source of mortality in California (Ames and Morejohn, 1980), is an important source of mortality in Alaska. With the exception of starvation following overpopulation relative to the available prey base and starvation due to rapid and severe sea-ice formation, well-documented instances of rapid, high levels of mortality have been directly or indirectly human caused. Information about the levels of take of sea otters associated with past oil spills; for subsistence harvesting by Alaska Natives; from illegal intentional killing incidental to commercial fisheries; and from other human-related causes in Alaska are discussed in Section V.C.5.f – Cumulative Effects.

III.B.4.b(9)(p)4)a) Starvation and Loss in Winter Storms

Deaths due to these two factors often cannot be separated because, as Kenyon (1969:261) cogently pointed out: "An emaciated and weakened animal is more subject to injury by large breakers than a strong one…" and an injured animal may be unable to feed. It has long been recognized that very old and young sea otters are vulnerable to storm injury (Barabash-Nikiforov, 1935).

Lensink (1962) reported that between 1949 and 1956, more than 400 sea otter carcasses were found on Amchitka beaches. Observations by others (for example, 124 counted in the late winter-early spring of 1949) and his own counts of large numbers of carcasses on beaches at Amchitka, led Kenyon (1969) to conclude that "considerable natural mortality," most likely due to density-dependent factors, occurred in the winter and spring at Amchitka, beginning at least in the winter of 1946-1947, although high numbers of carcasses were not reported until 1948 (Lensink, 1962). A high percentage of the otters found dead on Amchitka beaches in 1959, 1962, and 1963 showed signs of emaciation and hemorrhagic enteritis (Lensink, 1962; Kenyon, 1969) in addition to congested and frequently hemorrhagic lungs, hyperemic condition of intestinal surfaces (Lensink, 1962). "Prolonged storm conditions precipitated mortality but the amount of mortality was found, in 1962, to be related to the available feeding habitat and population density" (Kenyon, 1969:283). Lensink (1962) provides support for the idea that acute food shortages, rather than chronic starvation, likely precipitated the mortality of vulnerable age classes at Amchitka during winter storms. Lensink also (1962:116) reported that "Mortality is almost confined to the stormy period of late winter and Kenyon (1959a) has shown a direct correlation between individual storms and sea otter mortality." This pattern was confirmed by Kenyon (1969), who also concluded that the time of maximum mortality of Amchitka sea otters during the period of his study occurred during the winter and early spring, a time during which the Aleutians are subject to violent winter storms and long periods of high seas. A similar seasonal pattern of mortality was observed at Bering Island during a period of elevated mortality in 1990-1991 (Bodkin et al., 2000).

III.B.4.b(9)(p)4)b) Severe and Rapid Sea-Ice Formation

Significant mortality of sea otters caused by sea-ice formation has been reported in the Kuril Islands (Nikolaev, 1965) and in 1971, 1972, and 1974 north of the Alaska Peninsula (Schneider and Faro, 1975; Schneider, 1976). In 1971, large numbers apparently died of malnutrition, when ice formed rapidly around them and they had to travel long distances over ice or land in search of open water in which to feed. At least one was killed by a land predator. Schneider and Faro (1975:7) concluded that mortality due to ice formation in 1972 was "quite high," with a minimum of 200 estimated from those seen dead or near death. They believed that the number was, however, much higher: "…almost all of the otters northeast of Port Moller and about half of the otters between Port Moller and Cape Leontovich died…. The net result…was a reduction in numbers, although…not measurable with any present survey techniques…." (Schneider and Faro, 1975:97-98). The 1972 icing apparently caused little mortality. However, 1976 surveys showed that the range of the affected population was "…greatly reduced from that observed in 1970 as a result of mortality caused by extreme sea ice…in 1971, 1972 and 1974" (Schneider, 1976:635). Most of the animals found on shore near Cold Bay in 1972 were subadults, but many of those found on land in 1971 were adults (Schneider and Faro 1975).

In the Kuril Islands, sea ice-related mortality was observed at Uruppu Island, where ice often forms on the Sea of Okhotsk side, and sometimes encircles the entire island (Nikolaev, 1965; Schneider and Faro, 1975). At this location, a vigorous sea otter population apparently tolerated such conditions (Schneider and Faro, 1975).

III.B.4.b(9)(p)4)c) Predation by Bald Eagles

Eagles feeding on sea otter pups (scavenged or killed) has long been verified from studies on Amchitka Island. However, in both historic and recent studies, it is not clear what proportion of pups found in nests were scavenged, rather than killed, by eagles. Thus, the overall significance of the observations of otter pups in eagle nests and, thus, the effect of eagles on sea otter populations, is hard to assess. Gelatt (1996) recently concluded that bald eagles may be a significant sources of mortality of very young sea otter pups (at least at some locations, including at Amchitka in the Aleutians). However, evidence of eagles taking live pups is scarce (Kenyon, 1969:280; Sherrod, Estes, and White, 1975; Gelatt, 1996:62; Tinker and Estes, 1996:22). Further, evaluation of the importance of bald eagles as a source of predation on sea otters throughout the Aleutians, based on studies at Amchitka, is complicated by the fact that Amchitka is reported to have the densest population of bald eagles in the Aleutians (Faust and Bailey, 1995). While bald eagles are resident at many islands within the Aleutians, Faust and Bailey (1995) report they are absent from some (for example, Agattu and Nizki); their densities on the islands they inhabit vary, and alternate eagle prey also varies among islands.

Rates of eagles feeding on sea otter pups (killed or scavenged) appear to vary over time, even at Amchitka and there is considerable variability in the number of sea otter carcasses found in different nests (for example, see Murie, 1940; Krog, 1953, Lensink, 1962, Kenyon, 1969; Sherrod, Estes, and White, 1975; Gelatt, 1996). In June of 1993 and 1994, Gelatt (1996) found 20 individual sea otter pups in 14 (of 25) occupied nests on Amchitka Island. From these data and the approximate number of eagle nests on the island, these authors extrapolated to suggest that 40 sea otter pups might have been in nests during the short time period (June 10-15 1993, and June 16-20 1994) surveyed. Gelatt (1996:68) considered this number to be a minimum and concluded: "Although previously considered unimportant (Krog 1953, Lensink, 1962, Kenyon 1969), eagle depredation of sea otter pups at Amchitka appears to be more than compensatory and in a year of low pup production, could result in significant mortality in that particular cohort." Only very small (~ less than 3 weeks old) pups are found in nests (Gelatt, 1996).

III.B.4.b(9)(p)4)d) Predation by Orcas

Estes et al. (1998:474) stated:

> The collective evidence thus leads us to conclude that increased killer whale predation has caused the otter declines…(W)e estimate that a single killer whale would consume 1825 otters per year and thus that the otter population decline could have been caused by as few as 3.7 whales….

Estes et al. (1998) proposed that the frequency of predation on sea otters by orcas has recently increased, perhaps due to decreased abundance of Steller sea lions and harbor seals, potential alternative marine mammal prey. Orcas or "killer whales" (*Orcinus orca*) are known to kill sea otters but the level, purpose, and significance (Hatfield et al., 1998) of this killing is unclear.

Published accounts of orcas interacting with and, in a few cases, killing sea otters in Alaska are available from the Kuril Islands where an orca was reported to have caught one sea otter (Nikolaev, 1965:231); Amchitka (one confirmed contact caused by an orca breaching on the otter and otter not seen again; one breached on but no contact seen; one chase, no contact; one orca splash and aberrant sea otter behavior later) (Hatfield et al., 1998); Adak (one confirmed kill with observed consumption; one chase but no contact) (Hatfield et al., 1998); at a location unspecified in the Aleutians (one "attack," no details given) (Estes et al., 1998); and Prince William Sound (one confirmed kill and probable consumption; one definite bite and probable kill and possible consumption; and one possible attack where researchers and the pup's mother lost track of the pup after interaction with orcas) (Hatfield et al., 1998). However, as is can be seen by these numbers, the number of documented kills is low. Until recently, investigators generally have concluded that if orca predation of sea otters occurred, it was not a serious source of mortality (for example, Lensink, 1962; Kenyon, 1969; Rotterman and Simon-Jackson, 1988; Riedman and Estes, 1990). Research being conducted in the spring and summer of 2001 to investigate the role of orcas in the decline of sea lions in Alaska may provide information useful in evaluating this suggestion.

If orca predation is the primary, or even a significant, cause of the apparent decline of sea otters in the Aleutians, such predation could cause continued rapid and dramatic decline of sea otters in the Aleutians and/or prevent recovery of population levels to predecline levels, and could lead to population declines in other parts of the range. For example, if the suggestion is correct that a few individual orcas that switch prey and begin eating sea otters can drive down population numbers quickly, then sea otters in Prince William Sound (which are still recovering from the effects of the *Exxon Valdez* oil spill) also might begin to decline, because orcas have been observed attacking sea otters there (two instances of orcas killing sea otters and one additional possible attack resulting in possible killing of a pup) (Hatfield et al. 1998).

III.B.4.b(9)(p)4)e) Disease

Currently, no significant disease problems have been reported from recent or ongoing studies of sea otters in the Aleutians. Estes et al. (1998:475), citing a personal communication from D. Jessup, a Senior Wildlife Veterinarian, report the following: "Gross observation and hematological analyses of 66 sea otters captured at Adak, Amchitka, Kiska, and Kanaga Islands during the summer of 1997 failed to provide any known sign of disease. All of these animals appeared to be in excellent health." However, while current data do not indicate that disease is a significant cause of mortality in the Aleutians (Estes et al., 1998), the causes and rates of disease in sea otters in Alaska are much less-well studied than in California, where recent evidence suggests temporal changes in the impact of disease on the population. Thomas and Cole (1996) reported an unexpectedly high percentage (38.5) of the deaths of sea otters found dead in California between 1992 and 1995 were caused by various parasitic, bacterial, or fungal diseases. Thomas and Cole (1996:24-25) stated: "…that mortality from natural causes, specifically infectious diseases, is occurring at a high rate…. A state of general susceptibility is suggested by the variety of infections…." Acanthocephalan parasite-induced peritonitis was the single most frequent cause of death, being diagnosed for 14% of the otters examined in that study. Affected individuals were mostly (67% of those infected) pups or juveniles. The parasite responsible for the deaths was a *Polymorphus* spp. Another Acanthocephalan parasite found in sea otters in California, *Corynosoma enhydri* was not associated with noticeable adverse effects. Thomas and Cole (1996:24) conclude that "…the prevalence and intensity of *Polymorphus spp*. infections appear substantially greater…" than in previous studies. Other infectious diseases determined to have caused the deaths of sea otters found recovered in California between 1992 and 1995 were protozoal (*Toxoplasma gondii*) encephalitis (8.5% of the deaths; this disease is human associated, because the definite host for the infecting organism is the domestic cat); systemic infection with *Coccidioides immitis* (4%); and various bacterial infections (12%), most frequently strains and species of *Streptococcus*.

Sea otters in at least some parts of the Aleutians may have heightened vulnerability to disease, due to elevated organochlorine burdens and possible depletion of genetic variability. As the population level falls, and as the population becomes increasingly fragmented, the potential for disease to eliminate otters at specific sites grows.

In response to high levels of mortality of sea otters at Amchitka in the late 1940's and early 1950's, studies of sea otter parasites were initiated. Rausch (1953) identified 8 species from 31 sea otter specimens, of which he concluded that at least 2 (*Microphallus pirum* and *Porrocaecum decipiens)* were highly pathogenic. "Enteritis was the predominant symptom…(but) in a few instances…fatal idiopathic enteritis was noted. Rausch cautioned that "some other disease-producing factor may be in every case superimposed upon the *M. pirum* infection" (Lensink 1962:114-115). A sea otter in Prince William Sound apparently died as a result of a severe *Corynosoma villosum* infection (an Acanthocephalan) (Rausch, cited in Lensink 1962). F. Fay (cited in Kenyon, 1969:273) wrote that in 1962, a sea otter in Prince William Sound died "as a result of its dense, infiltrating parasite population, but it was not possible to decide which….*M. pirum*…" or *Terranova decipiens* "…was primarily responsible for…death." The trematode *Microphallus pyearum* and the bacterium *Clostridium* were both associated with enteritis in sea otters in the Aleutians, but the relationship between the organisms and the disease were not clear (Kenyon, 1969). Other disease-related causes of death reported for the Aleutians include liver degeneration, complications due to dental infection, malignancy, and paw infections (Kenyon, 1969). Monnett and Rotterman (1992a) documented an unexpected and precipitous decrease in the survival of radio-instrumented prime-aged animals in east Prince William Sound associated with the release back into the wild of sea otters from centers established after the *Exxon Valdez* oil spill. Patterns of mortality were consistent with an infectious disease being transmitted from released otters into the recipient population (Monnett and Rotterman, 1992a).

Some local residents of Cordova, Alaska have suggested that parasites and/or bone masses associated with wastes from fish-processing plants may be responsible for the deaths of sea otters in Orca Inlet (Associated Press, 2001). The Fish and Wildlife Service reports that at some locations, some sea otters have been obtaining scraps from commercial sportfishing boats and foraging on waste from seafood-processing facilities. An uncommon parasite (*Pseudoterranova* spp.) was present in necropsied animals that ate fish scraps. The Fish and Wildlife Service reports that it is unknown whether this parasite poses a population health risk in Alaska (USDOI, Fish and Wildlife Service, Region 7, Marine Mammals Management, coastal development web site).

III.B.4.b(9)(p)4)f) Environmental Contaminants

Exposure to persistent organochlorines, such as polychlorinated biphenyls (PCB's), polychlorinated dibenzo-p-dioxins (PCDD's), and other related compounds, threatens sea otters in the Aleutians and could be contributing to their decline through negative impacts on reproduction and survival.

Studies published by the Federal Government and other scientists have documented that some organochlorines are substantially elevated in sea otters livers at Adak Island (Bacon et al., 1999; Estes et al., 1997) compared with levels in those from California and especially from southeast Alaska. Average concentrations of PCB's (quantified as the sum of 48 congeners) in sea otter livers at Adak (309 micrograms per kilogram wet weight) were 38-fold higher than in southeast Alaska (8 micrograms per kilogram wet weight) and were also higher than levels in California (185 micrograms per kilogram wet weight (Estes et al. 1997). Estes et al. (1997:488) also reported that these PCB levels were "…similar to those causing reproductive failure in captive mink…." Levels of total DDT concentrations (Aleutians: 36 micrograms per kilogram wet weight; California: 846 micrograms per kilogram wet weight; Southeast Alaska: 1 microgram per kilogram wet weight) and average sums of "other" contaminants (total chlordane, PCDD's, polychlorinated dibenzofurans (PCDF's), hexachlorobenzene (HCB), dieldrin, and tris [4-chlorophenyl]-methanol) (Aleutians: 22 micrograms per kilogram wet weight; California: 43 micrograms per kilogram wet weight; Southeast Alaska: 5 micrograms per kilogram wet weight) in livers of sea otters from the Aleutians and from California were elevated relative to those from southeast Alaska (Estes et al., 1997). While further analyses of contaminants in sea otters from 39 sites within the Aleutians have shown that such elevated contaminant levels "…are restricted to a few small areas" (Estes et al. 1998:474, citing findings from Reese, 1998), bald eagle (*Haliaetus leucocephalus*) eggs from Adak, Tanaga, Amchitka, and Kiska islands in the west-central Aleutians also had elevated DDE (a metabolite of DDT) and PCB levels "…establishing the widespread occurrence of these compounds in the Aleutian archipelago…. Thus, detrimental impacts of OCs on these and other species in the Aleutian Islands are likely" (Estes et al. 1997:488).

Existing data are inadequate to determine whether organochlorines or other pollutants are affecting reproduction in sea otters at contaminated sites. Rates of reproduction and reproductive success have been conducted at only a few locations within the vast area in which the decline is occurring, and existing studies are inconclusive. Tinker and Estes (1996) reported that the estimated birth rate of sea otters at Adak was higher than that estimated for other locations, but that this may have resulted from relatively high rates of pup mortality. However, sample sizes for these portions of their study, and for the related study of pup survival during dependency, were small. Thus, conclusions about the impact of the contamination on sea otter reproduction at Adak are premature.

Reported effects of organochlorines include immunotoxicity, hepatotoxicity, neurotoxicity, reproductive and hormonal effects, abnormal effects on metabolism, mutagenesis and carcinogenesis, and/or skin lesions (Safe, 1984) in species such as dolphins in the Mediterranean (Poster and Simmonds, 1992); seals in the North and Baltic seas (Heide-Jørgensen et al., 1992); St. Lawrence estuarine beluga whales (Martineau et al., 1987); and fish-eating birds (Kubiak et al., 1989).

In pinnipeds, organochlorines have been associated with reproductive failures of seals in the Dutch Wadden Sea and elsewhere (Hutchinson and Simmonds, 1994); and in the American mink (*Mustela vison*), a species relatively closely related to sea otters, reproduction was inhibited at very low PCB intake (den Boer, 1983). In monkeys and other species, PCB exposures were found to have negative effects on birth weights, conception rates, and live birth rates. It is clear that the effects of PCB exposure on reproduction and related factors are likely to be long lasting. Effects in monkeys were observed long after the dosing with PCB's occurred. Sperm counts were reduced in rats exposed to PCB's. (Environmental Protection Agency Office of Pollution Prevention and Toxics website).

However, as, or possibly more, important than the potential impact(s) of PCB's on the reproduction of sea otters at some locations in the Aleutians are the potential impacts of PCB's on survival rates of all age classes of otters, due to their impacts on the immune system and their potential to predispose individuals with high contaminant loads to infectious disease. Chemicals such as PCB's, (PCDD's, and PCDF's have been found to be immunotoxic at low doses in studies of laboratory animals, and to accumulate in the tissues of higher trophic marine mammals such as seals (Van Loveren et al., 2000). Van Loveren et al. (2000:319) conclude "…that complex mixtures of environmental contaminants including PCBs, PCDFs, and PCDDs may represent a real immunotoxic risk to free-ranging seals." Coplanar PCB's have been associated with mass mortalities of seals in the North Sea and the Lake Baikal, epizootics in Mediterranean striped dolphin, and embryonic abnormalities in Great Lakes waterbirds (Tanabe, Iwata, and Tatsukawa, 1994). Some investigators have suggested that the primary lesion of the adrenals, one of a combination of lesions found in Baltic grey and ringed seals as a disease complex, may be caused by organochlorines, specifically by PCB's (Bergman and Olsson 1986;Olsson, Karlsson, and Ahnland, 1994). Findings from studies of potential associations between chronic exposure to PCB's and infectious disease mortality in harbour porpoises from England and Wales were "…consistent with the hypothesis that chronic PCB exposure predisposes harbour porpoises in UK waters to infectious disease mortality…" (Jepson et al., 1999:243). Tanabe, Iwata, and Tatsukawa, (1994:172) concluded that "…the present status of contamination by organochlorines in the marine ecosystems has also reached the critical point which might be enough to cause the induction of P-450 enzymes and disturbance of enbiotics in organisms…such as marine mammals."

Studies summarized by the Environmental Protection Agency (Environmental Protection Agency, Office of Pollution Prevention and Toxics Studies website) document many serious impacts of PCB exposure on the immune system of monkeys and other animals. These impacts include (1) a significant decrease in size of the thymus gland (a gland critical to the functioning of the immune system) in infant monkeys; (2) reduced responses of the immune system following a standard laboratory test that determines the ability of an animal to mount a primary antibody response and develop protective immunity; and (3) decreased resistance to viral and other infections. The Environmental Protection Agency writes: "Individuals with diseases of the immune system may be more susceptible to pneumonia and viral infections. The animal studies were not able to identify a level of PCB exposure that did not cause effects on the immune system."

There also is "…overwhelming evidence that PCBs cause cancer in animals…. The reassessment…concluded that the types of PCBs likely to be bioaccumulated in fish and bound to sediments are the most carcinogenic PCB mixtures." (Environmental Protection Agency Office of Pollution Prevention and Toxics website).

Regarding the sources of these contaminants, Estes et al. (1997) point out that Adak, Amchitka, and Kiska islands all were sites where past military activity occurred (coinciding with locations of high levels of PCB's in eagle eggs), whereas DDT and their metabolites probably have an Asian origin. Iwata et al. (1993) found high levels of residues of HCH's, another class of organochlorines, in surface seawater in samples from the open ocean sampled in the Gulf of Alaska in 1989 and 1990. High levels of organochlorine contamination have been found at numerous former military sites throughout Alaska and elsewhere in the Pacific. In the region of the present decline, there were, until very recently, military bases on Shemya (up to 900 persons) and Adak, an $86 million dollar over-the-horizon-radar site on Amchitka, a LORAN site on Attu (in the Near Islands (Campbell, 1995), Distant Early Warning line sites (which also often are associated with organocholorine contamination) on Umnak and Unalaska islands, and possibly other military sites that could have elevated levels of persistent organochlorine and other contaminants. More extensive testing of radiation and other contaminants on Amchitka is taking place. In 1995, the Fish and Wildlife Service "…was coordinating cleanup from military activity on national wildlife refuge lands throughout the Aleutians, including Amchitka…. The naval installation on Adak is already listed …" as a Superfund site, and cleanup was underway at Shemya (Campbell 1995). Thus, there are numerous contaminated sites in the Aleutians and, due to the nature of the islands, the possibility for contamination of sea otter habitat is substantial. The habitat of the sea otter in these remote regions clearly has been significantly contaminated and otherwise degraded by humans.

III.B.4.b(9)(q) Movements of Sea Otters

Large amounts of information on the movements of large numbers of individual sea otters is available only from Prince William Sound and California. Only at those locations have studies of radio-instrumented animals been conducted with sufficient aircraft monitoring to enable the reliable monitoring of mobile individuals. Even at these two well-studied locations, gaps in knowledge of movements exist. It is likely that available information about movements is biased downward (i.e., sea otters probably typically move more than most summaries indicate), because long-distance movements often are abrupt and require extensive searching by aircraft to detect (Monnett, 1988).

The extent of movement in sea otters varies with age, sex, reproductive status, and season (Monnett, 1988). Individual sea otters vary greatly in the extent of their mobility. Both males and females can make long movements (for example, 50 to greater than 80 kilometers), traveling between sites used seasonally (Garshelis and Garshelis, 1984; Monnett, 1988) or during mass movements during recolonization (for example, movements from the Rat Islands to the Near Islands) (for example, Kenyon, 1969). Individual adult females use a considerable portion of the entire female area, but their destination and their relative mobility changes seasonally, whether or not they are accompanied by a pup, and with the age of their pup (Monnett, 1988). Conversely, both males (for example, territorial males that remain on territory year-round) (Garshelis and Garshelis, 1984; Monnett, 1988; Tinker and Estes, 1996) and females with pups nearing weaning (Monnett, 1988) can be relatively sedentary. Male weanlings travel farther from their weaning site (which usually is in a "female area") than do female weanlings (Monnett, 1988), but both sexes tended to make a long distance movement from the weaning site…" (Monnett, 1988:16-17).

Deep, wide channels with strong current can act as barriers to sea otter movements but not usually an impenetrable one, greatly reducing, but not eliminating, movement of sea otters across such a channel (for example, Lensink, 1962; Kenyon, 1969; Monnett and Rotterman, 1992b). For example, Kenyon (1969:194) stated: "The 55 miles of open water between Buldir and Kiska was an effective but not a permanent barrier. The 30 miles of deep open water between Amchitka and Semisopochnoi was apparently…less effective…." However, the approximately 185 miles of open sea between the Near and Commander islands appears to be an effective barrier (Kenyon, 1969). Habitat differences impact home-range size (Garshelis and Garshelis, 1984).

During recolonization, sea otters tend to move into unoccupied areas primarily in response to "population pressure" (i.e., the local population has grown large). Kenyon (1969) cites emigration of significant numbers of individuals from highly populated Kanaga to unpopulated Adak and later relatively rapid emigration from Adak to unpopulated or underpopulated islands to its east.

In many locations, including the Aleutians, sea otters regularly haul out on rocky points, islets, spits, sand beaches (Kenyon, 1969), or mud bars (Monnett and Rotterman, 1989b). The reported incidence of hauling out behavior varies among locations and is generally higher in Alaska than in California, possibly due to disturbance directly and/or indirectly related to humans (Rotterman and Simon-Jackson, 1988), to colder temperatures in Alaska (Garshelis, 1983), and/or to rougher seas and, in some locations, the disappearance of kelp beds in the winter in Alaska (Gelatt, 1996). At Amchitka, sea otters spent more time hauled out during stormy weather, especially during periods of high winds and seas during the winter (Kenyon 1969; Armstrong, 1977). They are vulnerable on land. They can walk or bound on land, but unlike river otters, do not appear to run (Tarasoff and Whitt, 1972). When bounding, their speed is "…somewhat less than the running speed of a normally agile man" (Kenyon, 1969:71). Very old and large adults "seem unable to raise their bodies from the ground…" (Kenyon, 1969:71).

Sea otters have been observed walking overland and over ice. However, in most cases involving land travel over extensive distance (for example, greater than that mentioned in the previous paragraph related to onshore resting sites), this is in response to desperate conditions such as extreme ice formation (Schneider and Faro 1975:98).

III.B.4.b(9)(r) Habitat Associations

The range of sea otters is restricted to those areas where suitable habitat is close enough to permit regular feeding; where shelter from winter storms can be found, if necessary; where females with small pups can feed; where pups can be weaned; and where weanlings can survive over their first year, when diving abilities are maturing. Near Amchitka, Kenyon (1969) reported that sea otters generally feed in intertidal and subtidal areas in habitat less than 30 meters deep. However, in other areas of Alaska, sea otters have been observed feeding in much deeper habitat (Garshelis, 1987). Because the diving abilities of young otters permit feeding only in areas much shallower than this, they can occupy only a subset of the total habitat available to the population as a whole. In several areas, sea otters are known to range far offshore. The most widely known and best understood example of this is in the area of the southern Bering Sea, north of the Alaska Peninsula and Unimak Island. While "…few animals stray beyond the 80 meters contour" Scheider (1976:635) reported that an area "(B)etween Cape Mordvinof and Cape Lieskof, "from shore seaward to the 60 meters contour…should be considered an area critical to the survival of this population…." Other instances of significant numbers of sea otters ranging far offshore also exist, including some in the western Aleutians, west of Unimak Pass. In the summer of 1959, for example, many sea otters were observed "…up to 8 miles seaward on the south side of Kiska Island" (A. Hartt, cited in Lensink, 1962).

Physical features of important sea otter habitat include, but are not limited to bays, lagoons, and other sheltered areas; areas with waters less than 30 fathoms deep (Kenyon, 1969); areas with surface canopies of kelp (Kenyon, 1969); "…areas which offer an abundant invertebrate bottom fauna and sheltered feeding and resting areas" (Kenyon, 1969:57); and all known offshore areas where large aggregations of sea otters have been observed. Other physical features are evident from descriptions of key types of habitats. Large groups of sea otters often are found near "…prominent points or capes, offshore islets, and occasionally the entrance to large bays…" (Lensink, 1962:70). In the Aleutians, haulouts often are on rocky points but also can be on sand beaches, spits, or islets (Kenyon, 1969). Kenyon (1969:57) states that "sea otters favor waters adjacent to rocky coasts near points of land, or large bays where kelp beds occur. Coasts adjacent to extensive areas of underwater reefs are particularly attractive." "Favored sea otter habitat in the Aleutian Islands is characterized by having extensive underwater reefs to a depth of about 20 fathoms, kelp beds, and points of land or offshore rocks that give shelter during storms" (Kenyon, 1969:58). According to Evans, Burn and DeGange (1997:6), "(L)arger groups of sea otters were often found in bays, fjords, narrow passages between islands, and other protected areas."

III.B.4.b(9)(s) Feeding Behavior and Prey

Sea otters most frequently prey on subtidal organisms, but prey located in intertidal zones also is important, especially to some age classes (for example, juveniles) and in some regions (for example, parts of Prince

William Sound). Sea otters have been observed to eat a wide variety of prey, and variation exists among common prey eaten at various locations throughout the range (for example, fish are an important component of the diet at Amchitka Island but are rarely eaten at more recently occupied locations within the Aleutians) (Estes, Jameson, and Rhode, 1982). A full presentation of sea otter eating habits is beyond the scope of this document. We focus on prey known to be consumed in parts of Alaska from Prince William Sound westward, excluding prey documented only in southeast Alaska and points south.

All reports about sea otter diet and foraging habits are likely to contain a known amount of error. This error results from the facts that sea otters may consume some prey underwater and/or consume prey that observers cannot distinguish from a distance, and that information about feeding habits obtained through the examination of scats is biased because all prey is not equally identifiable in feces (for example, some prey cannot be detected at all).

Studies from a few locations in the Aleutians recently occupied by sea otters indicate that sea urchins, mollusks, and crustaceans are the primary sea otter prey (Riedman and Estes, 1990). At Amchitka Island, a location inhabited by relatively large numbers of sea otters for a long time, fish (for example, Kenyon, 1969; Cimberg and Costa, 1985) are an important component of the diet (Riedman and Estes, 1990). Other species eaten include limpets (*Tonicella* and *Shizoplaz*) and several species of snails (Lensink, 1962), shrimp, amphipods, and sand dollars (*Echinarachnius parma)* (Cimberg and Costa, 1985). In the mid-1990's, sea urchins and bivalves were the most common prey types on the outer coast of Adak Island but within Clam Lagoon, an area with a soft mud bottom lacking kelp forests, the predominant prey were bivalves. In both locations, sea otters also were observed to eat worms (in Clam Lagoon, especially fat innkeepers), fish, and crustaceans (Tinker and Estes, 1996).

Based on Johnson and Garshelis (1995:Figure 18), sea otter prey in west Prince William Sound includes primarily clams (usually greater than 60% and up to greater than 75%) (Garshelis, Garshelis, and Kimker, 1986:640 for a species list); blue mussels (6 -greater than 20%); helmet (*Telmessus cheiragonus*) and other (*Cancer spp*.) crabs (~7%-13%); "worm-like organisms," mainly fat innkeepers (*Echiurus echiurus*) (2%-~10%); and kelp (0%-~5%). Prespill, clams, mussels, and crabs combined comprised about 96% of the documented diet of sea otters near Green Island (Garshelis, 1987). Other prey documented in Prince William Sound include urchins (*Strongylocentrotus spp.),* sea stars, annelids, and octopi (*Octopus spp.)* (Garshelis, Garshelis, and Kimker, 1986; Garshelis, 1987; Johnson and Garshelis, 1995). Sea otters also occasionally prey on seabirds (Kenyon, 1969; VanWagenen et al., 1981).

In Alaska, studies (for the Aleutian Islands: Lensink, 1962, Kenyon, 1969; Tinker and Estes, 1996; for reviews see Rotterman and Simon-Jackson, 1988, VanBlaricom and Estes, 1988, and Riedman and Estes, 1990) have documented sea otter consumption of the following prey species (those that have been documented to be eaten in the Aleutians are starred):

- Bivalves: *Clinocardium ciliatum* (cockle)*, C. *nuttallii, Hiatella arctica*, *Humilaria kenerlia, Liocyma viridis*, Macoma incongrua, M. inquinata, M. sp.*, Modiolus modiolus*, Musculus discors*, Musculus sp*., *Mytilus edulis** (blue mussels), *Mya arenaria, M. truncata, Panopea generosa, Pecten beringianus*, P. islandica*, Pododesmus macroschisma** (rock jingle), *Protothaca staminea, Saxidomus giganteus, Serripes groenlandicus* (cockle)*, *Tresus capas, T. nuttallii*, Venericardia paucicostatus**;
- Gastropods: *Argobuccinium oregonensis*, Buccinium sp.*, Natica clausa*, Notoacmaea persona, Tectura spp.*, Thais sp*.*;
- Decapods: *Cancer magister, C. oregonensis*, C. sp*.* (crabs); *Chionecetes bairdi*, Dermaturus mandtii*, Pagurus gilli*, P. hirusutiusculus*, P. sp*.*, *Placetron wosnessenski*, Sclerocrangon boreas*, Telmessus cheiragonus** (helmet crabs);
- Isopods*: Idotea* sp.*; unidentified Isopod sp.*;
- Polypacophora*: Cryptochiton stelleri*, Mopalia sp*.*, limpets *Collisella pelta*, Schizoplax brandtii*, Tonicella marmorea*, T. ruber*;
- Echinoderms: *Dendraster excentricus*, Strongylocentrotus drobachiensis*. S. polyacanthus* (sea urchins), *Asterina miniata*, Ceramaster sp*.*, *Evasterias troschelii, Henricia sp*.*, *Leptasterias sp*.*, *Pycnopodia helianthoides*; Brittle stars*; *Cucumaria sp*.* (sea cucumber);
- Cephalopods: Octopus *sp*.*;
- Annelids, including*: Arenicola sp*.*, *Eudistylia* sp., *Nereis sp*.*;

- Other invertebrates: *Tunicata**; an unidentified Amphipod *sp.**; fat innkeepers, *Echiurus echiurus*; *Emplectonema sp.**; *Porifera* (sponge)*; sea anenome*;
- Fish: *Ammodytes hexapterus** (sand lance), *Anoplopoma fimbria*, Aptocyclus venticosus* (lump sucker)*, *Cottidae* (sculpin)*, *Cyclopterichthys glaber*, Gadas morhua*, Gymnocanthus pistilleger*, Hexagrammos superciliosus*, H. lagocephalus* (rock greenling)*, *Hemilepidotus hemilepidotus*, Hippoglossus stenolepis* (flatfish)*, *Lepidopsetta bilineata*, Pleurogrammus monoterygius**; fish egg mass*;
- Birds: *Anas crecca**;
- Plants: Kelp*;
- *Balanus sp.*: (barnacle)*.

III.B.4.b(9)(t) Ecological Interactions

Comparisons of nearshore ecological communities in which sea otters currently are present versus those in which they are absent (for example, Estes and Palmisano, 1974; Duggins, 1980; Breen et al., 1982), comparison of such communities over time as sea otters recolonize areas of their historic range (for example, VanBlaricom, 1984; Estes and Duggins, 1995), and experimental modification to simulate the impacts of sea otter predation (for example, Duggins, 1980) have led to the assertion that sea otters are a "keystone species" (as defined by Paine, 1966; Paine and Vadas, 1969). Sea otters in the Aleutians are considered a "keystone species," precisely because evidence shows that "by preying on the animals that graze on kelp, otters in the Aleutian Islands affect the structure of the entire coastal environment" (Palmisano and Estes, 1976:46). They are "important in determining littoral and sublittoral community structure" (Estes and Palmisano, (1974:1,058).

Available studies indicate that high densities of otters apparently are the reason why kelp beds and algae dominate certain nearshore environments. By preying on, and significantly reducing the populations of sea urchins and other invertebrates, such as chitons and limpets that eat algae and kelp, sea otters permit an increase in kelp forests (Palmisano and Estes, 1977; Duggins, 1980) over a wide area of their range in the North Pacific (Riedman and Estes, 1990). This increase in kelp forest has multiple and important impacts on the coastal environment. For example, the abundance of some fish species, such as the rock greenling, may be tied to the distribution and abundance of kelp which may provide egg laying habitat, serve as a refuge from certain predators, and provide habitat and food for some fish prey. Simenstad, Estes and Kenyon (1978) reported that "…the association of macroalgae" (which, in the Aleutians, appears to depend on sea otter presence and consumption of herbivorous sea urchins) "is the major source of marine primary production in the western Aleutian Islands and other north temperate areas…. Consequently, islands lacking sea otters…apparently are relatively unproductive compared with islands where sea otters are abundant." "Furthermore, fish constitute a critical link in the food web leading to higher-level predators" (Palmisano and Estes, 1976:51). Additionally, the presence of kelp forests modifies water flow, in some cases buffering inshore areas from waves (Riedman and Estes, 1990). Kelp may be an important source of organic carbon in nearshore communities in the western Aleutians (Duggins, Simenstad, and Estes, 1989).

At some locations, high densities of small sea urchins can survive despite high densities of sea otters (Riedman and Estes, 1990). Populations of certain benthic invertebrates, such as abalone (*Haliotis spp*.), Dungeness crabs, Pismo clams (*Tiuela stultorium*), and mussels (*Mytilus spp*.) can be limited in some areas by severe sea otter predation (see discussion and references in Rotterman and Simon-Jackson, 1988, Van Blaricom and Estes 1988, Riedman and Estes, 1990). Garshelis et al. (1984) reported that sharp declines in Dungeness crab populations in the Orca Inlet region of east Prince William Sound resulted from heavy sea otter predation, but ecological changes caused by the 1964 Good Friday earthquake (Estes and VanBlaricom, 1985) and changes in cannery discharge practices in the inlet (Rotterman and Simon-Jackson, 1988) confound interpretation of this case. Circumstantial evidence indicated that the variability in density and size structure of intertidal mussels resulted from sex- and age-specific predation by sea otters (VanBlaricom, 1987). Studies conducted in soft-bottom habitat showed little impact of sea otters on the density or size distribution of infaunal bivalves (Kvitek and Oliver 1988; Kvitek et al., 1988).

Recent reports indicate that the decline of sea otters already has led to changes in some nearshore ecological communities in the Aleutians. Estes et al. (1998:474) reported: "Strikingly rapid changes in the kelp forest ecosystem have accompanied the sea otter population declines" (see Estes et al., 1998:Figure 1)." Studies of kelp forests at Adak Island in 1987 and again in 1997, dates spanning a period during which survey data indicate sea otters in the area declined precipitously, show that "…sea urchin size and density increased to produce an eight-fold increase in biomass, while kelp density declined by more than a factor of 12…. The average rate of kelp tissue loss to herbivory increased from 1.1% per day in 1991 to 47.5% per day in 1997 (Figure 1). Observations made in …1997…revealed similar changes at Kiska, Amchitka, and Kagalaska Islands" (Estes et al., 1998:474).

III.B.4.c. Birds

III.B.4.c(1) Steller's Eider *Polysticta stelleri* (Alaska breeding population) – Threatened

III.B.4.c(1)(a) Summary

The Steller's eider is a threatened sea duck. The smallest of the eiders, it averages about 800 grams (1.8 pounds) in weight (both sexes) (USDOI, Fish and Wildlife Service, 2002c). Adult males and females are distinguishable. Steller's eiders nest in arctic and subarctic tundra, feed by dabbling and diving for mollusks and crustaceans, and move to shallow, nearshore marine waters along the Alaska Peninsula to molt. They overwinter in the same and similar type of habitat in much of southwest and southcoastal Alaska, including areas adjacent to, nearby or, less likely but possibly within the proposed multiple-sales area. Thus, there is potential for Steller's eiders that winter in nearby areas to be affected by activities associated with the proposed Cook Inlet OCS oil and gas lease sales in a portion of its wintering grounds (see Figure III.B-5). However, in a February 18, 2003, memorandum at the conclusion of consultation under Section 7 of the ESA (this memorandum is incuded in Appendix C), the Fish and Wildlife Service concluded that "Stellers eiders are not known to occur within the action area."

Birds from different breeding populations are indistinguishable but available information indicates they intermix, at least in some areas, on the wintering grounds. Thus, it is not known what percentage of the birds that overwinter in areas within or near the proposed multiple-sales area is from the American breeding population, which is listed under the ESA, and what proportion is from the Russian Pacific breeding population, which is much more abundant. Thus, there is uncertainty about how many individuals from the Alaska breeding population overwinter in areas that could be impacted by the Proposed Action. According to the Fish and Wildlife Service, about 4.2% of the Steller's eiders in or near the Cook Inlet Planning Area are assumed to be from the Alaska breeding population (see the following subsection III.B.4.c(1)(g).

While the breeding range of the Alaska breeding population is thought to have contracted considerably from the historic breeding range, and the frequency and occurrence of nesting have declined in the current breeding range, reliable estimates of current breeding abundance are unavailable (66 *FR* 8850). Further, as Flint et al. (2000:261) recently summarized: "Little is known about the life history and biology of Steller's eiders." This lack of information hampers efforts to evaluate potential impacts of the Proposed Action on this species.

III.B.4.c(1)(b) Current Species and Population Definitions

The taxonomic designation of this species has undergone numerous changes (see 66 *FR* 8850 for discussion). However, because Steller's show considerable distinction from other eiders (66 *FR* 8850), they have been designated as a separate genus, *Polysticta*, and are the only representative of this genus (American Ornithologists' Union, 1983).

The Fish and Wildlife Service currently recognizes three breeding populations of Steller's eiders: a Russian Atlantic, a Russian Pacific, and an Alaska breeding population (66 *FR* 8850). The Fish and Wildlife Service ((USDOI, Fish and Wildlife Service, 2002f) reported that the Alaska breeding population is further comprised of two subpopulations: a northern Alaska subpopulation and a western Alaska subpopulation (USDOI, Fish and Wildlife Service, 2002f). Available evidence indicates that for the autumn molt, the overwintering period, and the spring migration, the Alaska and Russian Pacific breeding populations intermix (USDOI, Fish and Wildlife Service, 2002f). Steller's eiders from the Alaska breeding population and those from the Russian breeding populations are visually indistinguishable.

Because only the Alaska breeding population is listed under the ESA, we confine our discussion to this population, considering information about the Russian population when it facilitates the evaluation of potential effects from the Proposed Action on the Endangered Species Act listed population or on the significance of any effects.

III.B.4.c(1)(c) Current Endangered Species Act Status and Protective Legislation

The Alaska breeding population was listed as threatened under the ESA in June 1997 (62 *FR* 31748). A determination that this population is threatened was based primarily on the "…near disappearance of Steller's eiders from the Y-K Delta and the indication that they may have abandoned the eastern North Slope (66 *FR* 8853). The Fish and Wildlife Service also reported that, at the time of listing in 1997, "…there was inadequate quantitative information available to assess population size or trends" (66 *FR* 8853). Other evidence supporting listing was a reduction in the number of this species nesting in Alaska, and the resulting vulnerability of the remaining breeding population to extirpation (62 *FR* 31748). Neither Russian population is listed or proposed for listing under the ESA.

Critical habitat for the Alaska breeding population was designated in February 2001 (66 *FR* 8850), and became effective on March 5, 2001 (66 *FR* 8850). The designation included breeding habitat on the Yukon-Kuskokwim Delta and four marine areas used for molting and overwintering in southwest Alaska (Kuskokwim Shoals in Kuskokwim Bay and three areas on the north side of the Alaska Peninsula [Sea Islands, Izembek Lagoon, and Nelson Lagoon]; (see Figure III.B-8). There is no critical habitat designated for this species in or near the planning area or any areas south of the Alaska Peninsula. The Fish and Wildlife Service initiated recovery planning in 1997. A Recovery Plan was finalized on September 30, 2002 (68 *FR* 20020).

In 1994, the Fish and Wildlife Service included Steller's eiders on the closed season species list under the Migratory Bird Treaty Act, which means that it is illegal to take this species during any season. While the Migratory Bird Treaty Act recently was amended to govern spring and summer hunting of waterfowl by subsistence hunters in Alaska, take of Steller's eider is still prohibited under the new regulations (USDOI, Fish and Wildlife Service, 2002f).

Steller's eiders are listed by the state of Alaska as a Species of Special Concern. Sport and subsistence harvest is no longer permitted (Quakenbush and Suydam, 1999). In the Yakutsk Republic in Russia, Steller's eiders have received a protective designation similar to that of threatened status under the ESA (Kertell, 1991; Flint et al., 2000).

III.B.4.c(1)(d) Distribution, Abundance, and Habitat Associations

Steller's eiders nest in coastal areas (but up to 90 kilometers from the coast) during the summer. After nesting, they migrate to nearshore shallow marine waters to molt and then disperse further to the same and more extensive marine areas to spend the winter. Data on abundance are relatively incomplete. At the time of listing, the Fish and Wildlife Service concluded that quantitative information was inadequate to assess population size or to evaluate population trends (66 *FR* 8850).

III.B.4.c(1)(e) Breeding

Steller's eiders make a small nest lined with down in a depression in tundra near small ponds or within lake basins and occurs on tundra. One to eight eggs are laid, and young typically hatch in late June after an incubation of approximately 25 days (Quakenbush et al., cited in USDOI, Fish and Wildlife Service, 2002f). Ducklings follow females to nearby wetlands shortly after hatching and feed on aquatic insects and plants until ready to fly at about 40 days of age (Obritschkewitsch et al., 2001).

Flint et al. (2000) report that breeding propensity and success vary annually at specific locations. However, on a worldwide basis, the vast majority (~96%) of Steller's eiders currently breed in two populations in Russia: an Atlantic and a Pacific population (see Solovieva, 1997 and USDOI, Fish and Wildlife Service, 1998 for a description of distribution and abundance in Russia). The Russian Pacific population, which commingles during the nonbreeding season with the Alaska breeding population (see the following discussion on breeding), is known to nest east of the Khatanga River (USDOI, Fish and Wildlife Service, 2002c). Aerial surveys of key nesting areas in Russia during 1993-1995 suggested a minimum of 149,000

Steller's eiders (USDOI. Fish and Wildlife Service, 1999, cited in USDOC, NOAA, National Marine Fisheries Service, 2001).

The historical breeding range of Steller's eiders in Alaska is uncertain. However, available information indicates that the current breeding range is substantially reduced compared to the range occupied previously, and that within the current range, their densities are very low. The historic breeding range probably was discontinuous. It may have extended from the eastern Aleutians (Gabrielson and Lincoln, 1959), the Alaska Peninsula (Murie and Scheffer, 1959), the Seward Peninsula (Portenko, 1989) and, as recently as the 1950's, on St. Lawrence Island (Fay and Cade, 1959), to the western and northern coasts of Alaska and possibly to the Canadian border. In the early 1900's, Steller's eiders were termed a locally "common" breeder in the central Yukon-Kuskokwim Delta of southwestern Alaska (for example, Murie, 1924; Conover, 1926; Brandt, 1943). However, their true "commonness" is uncertain because they were only reported to breed in a few locations.

The known numbers of birds breeding on the Yukon-Kuskokwim Delta, the Arctic Coastal Plain of Alaska, and in Siberia have declined (Kertell, 1991; Flint and Herzog, 1999; Flint et al., 2000). The listing of the Steller's eider under the ESA was prompted by the near disappearance of this species from the Yukon-Kuskokwim Delta and by indications that they may have ceased nesting on the eastern North Slope (66 *FR* 8850).

By the 1960's or 1970's, Steller's eiders were rare on the Yukon-Kuskokwim Delta. No nests were found from 1975-1994, and only six nests were found in the 1990's, suggesting that a few Steller's eiders continue to nest on the Delta (USDOI, Fish and Wildlife Service, 2002f). However, there are no reliable estimates of current breeding abundance for the Yukon-Kuskokwim Delta (see Figure 4 of USDOI, Fish and Wildlife Service, 2002 for historic and current breeding nest distribution of Steller's eiders on the Delta).

At present, Steller's eiders currently are known to breed on the western North Slope, with most sightings in the past 10 years being within 56 miles (90 kilometers) of the coast east of the mouth of the Utukok River, west of the Colville River. The Fish and Wildlife Service (2002:3) reports that while the lack of recent observations on the eastern Arctic Coastal Plain may indicate the range has recently contracted, they caution that "…the few…historical observations form a poor basis for quantitative comparison." Quakenbush and Suydam (1999) report that the largest number of nests are found near Barrow, with very low densities of nests also being detected across the Arctic Coastal Plain as far east as Prudhoe Bay. Years during which Steller's eiders were observed to nest in areas near Barrow corresponded with years of high numbers of lemmings (Quakenbush and Suydam, 1999).

Good data are not available on which to evaluate trends in abundance of breeding Steller's eiders in northern Alaska. Point estimates of the size of the breeding population of Steller's eiders in northern Alaska based on aerial waterfowl surveys from 1989-2000 ranged from 281-2,543 (Mallek, 2001), indicating that "…hundreds or low thousands of Steller's eiders occur on the North Slope" (USDOI, Fish and Wildlife Service, 2002f:6). However, the Fish and Wildlife Service (2002) report that these estimates likely are underestimates, because it is unknown what proportion of birds are missed during the surveys and no species-specific correction factor is available for Steller's eiders.

III.B.4.c(1)(f) Molting, Wintering, and Spring Staging

Males depart the nesting areas in late June, while females with broods apparently remain until late August or early September. After nesting, Steller's eiders from both Arctic Russia and Alaska aggregate in protected marine areas, where they undergo a complete molt of their flight feathers over a period of about 3 weeks (Jones, 1965; Petersen, 1980, 1981; USDOI, U.S. Fish and Wildlife Service, 2002). In Alaska, the period of molting lasts from late July through late August (USDOI, Fish and Wildlife Service, 2002c). Studies indicate that during autumn molt and winter and spring migration, Steller's eiders from the listed Alaska breeding population and the Russian populations intermingle in marine areas of southwest Alaska. The relative contribution of the different breeding populations to wintering groups in different area is unknown (66 *FR* 8850). It is not known whether, and to what extent, eiders from the Alaska breeding population tend to aggregate in specific regions (66 *FR* 8850). However, recoveries of the bands of individuals captured during the molt in Izembek Lagoon suggested that birds from both Russian and Alaskan breeding populations molted along the Alaska Peninsula (Dau, Flint, and Petersen, 2000). Recent preliminary satellite telemetry data indicate that the Kuskokwim Shoals are particularly important to Steller's eiders from the Alaska breeding population during the molt and for spring staging (Martin, 2003, pers. commun.).

In Alaska, concentrations of molting Steller's eiders have been reported in the Bering Sea near St. Lawrence Island and along the northern shore of the Alaska Peninsula at four locations: Izembek Lagoon, Nelson Lagoon, Seal Islands, and Port Heiden (Gill, Petersen, and Jorgensen, 1981, Petersen, 1981; Metzner, 1993) areas characterized by extensive shallow areas with eelgrass beds (*Zostera marina*) and intertidal mudflats and sandflats containing Steller eider prey such as mollusks and small crustaceans (see below) (Petersen, 1981; Metzner, 1993; Larned and Zweifelhofer, 2001). Huge aggregations (see the following paragraph) are found along the northern Alaska Peninsula, especially on the Izembek National Wildlife Refuge (Quakenbush and Suydam, 1999). For example, tens of thousands of Steller's eiders use Izembek Lagoon during the molt, with an average of approximately 23,000 (range 6,570-79,970) individuals observed during censuses conducted between 1975-1996 (Dau, 1999, cited in 65 *FR* 13262). It is believed that a large percentage of the Russian Pacific and Alaska breeding populations winter in these areas (Jones, 1965; Flint et al., 2000).

After molting, thousands of Steller's eiders remain in the lagoons used for molting, but thousands also disperse to shallow (less than 10 meters deep), often nearshore (typically within 400 meters of shore) or reef areas in marine waters adjacent to the Aleutian Islands, the south side of the Alaska Peninsula, the Kodiak Archipelago, and Cook Inlet (USDOI, Fish and Wildlife Service, 2002f). Thousands to tens of thousands of Steller's eiders stage in many of the same primary areas used for molting and wintering (i.e., Izembek and Nelson lagoons, Seal Islands, and Port Heiden). All Alaska-wintering adult Steller's eiders may spend days or weeks resting and feeding in northern Kuskokwim Bay and associated bays prior to continuing their northward migration to reproduce (USDOI, Fish and Wildlife Service, 2002f).

Both males and females showed high (greater than 95%) rates of fidelity to specific molting sites within lagoons, but location of molting did not affect annual survival (Flint et al., 2000).

Concurrent with the decline in the abundance of Steller's eiders breeding in western Alaska, available data indicate that numbers of Steller's eiders molting and wintering along the Alaska Peninsula have declined since the 1960's (Jones, 1965; Kertell, 1991; Flint et al., 2000). Larned (2001) presented estimates of prebreeding population size from aerial spring surveys of southwestern Alaska from Cape Romanzof on the Yukon-Kuskokwim Delta to Chignik Bay on the south side of the Alaska Peninsula. Peak estimates, unadjusted for observer bias, were 137,904 in 1992; 88,636 in 1993; 107,589 in 1994; 90,269 in 1997; 84,459 in 1998; 72,953 in 2000 (an unexpanded total for this year, which Larned stated is more comparable to previous years is 68,956); and 60,656 in 2001 (with the unexpanded total for 2001 being 58,231). Larned (2000) reported that data indicate a 6.1% annual decline in abundance of prebreeding population size. Larned (2001) reported that survey data indicated a 7.2% annual decline in migrating Steller's eiders ($R^2 = 0.806$). In the 2000 spring survey, the five areas with the highest estimated numbers of Steller's were Izembek Lagoon (33,374), Port Heiden (7,375), Nelson Lagoon (7,321), Kuskokwim River to Security Cove (4,538), and Port Moller (5,046) (Larned, 2000). In the 2001 spring survey, areas with the highest estimated numbers of Steller's were Izembek Lagoon (24,096), Toksook Bay to Kuskokwim River (9,918), Port Heiden (7,875), Seal Islands Lagoon (2,905), Kuskokwim River to Security Cove (2,883), and Port Moller (2,741), Chagvan Bay (2,451), and Nelson Lagoon (1,787) (from Table 1 in Larned, 2001). Larned (2001) reported that Steller's eider patterns of habitat use during migration were similar among years, indicating numerous important spring habitats.

A small number of Steller's eiders are known to remain in some marine areas, including Kachemak Bay during the summer (C. Dau, cited in USDOI, Fish and Wildlife Service 2000).

III.B.4.c(1)(g) Use of Areas Near the Multiple-Sales Area

Steller's eiders are not reported to nest in any locations within or near the proposed multiple-sales area. However, as previously noted, a relatively small number of Steller's eiders (~ 100) also have been observed to remain in Kachemak Bay during the summer (C. Dau, cited in USDOI, Fish and Wildlife Service, 2000). "There are no reports of molting Steller's eiders anywhere along the south side of the Alaska Peninsula between False Pass and lower Cook Inlet" (65 *FR* 13271). Available evidence indicates wintering Steller's eiders are widely scattered throughout the very large area, including in shallow, nearshore marine areas near, and less likely within, the proposed Cook Inlet multiple-sale area (65 *FR* 13262). These areas include parts of nearshore areas of eastern Lower Cook Inlet, Kachemak Bay, Kamishak Bay, and parts of the Kodiak Archipelago (see details in the following paragraphs).

While the number of Steller's eiders observed has varied considerably, and data currently are insufficient to rigorously estimate abundance, Steller's eiders are present in relative low abundance and density (see the following) in areas near the proposed multiple-sales area compared to areas such as Nelson and Izembek lagoons. The Fish and Wildlife Service (65 *FR* 13262) speculated that when wintering birds from the north side of the Alaska Peninsula are excluded from protected waters by ice, they may be forced to "…less preferred feeding areas on the south side of the Alaska Peninsula and up to lower Cook Inlet" (65 *FR* 13271). The Fish and Wildlife Service concluded (66 *FR* 8863) that neither the Kachemak Bay/Ninilchik, Kodiak Archipelago, nor the south side of the Alaska Peninsula (marine wintering areas that could conceivably be impacted by the Proposed Action) "…regularly contain greater than 5,000 individuals…," and "…that the available information does not demonstrate that any of these areas are essential for the recovery of the Alaska-breeding population of the Steller's eider."

Individuals that are observed during the winter in the Cook Inlet and/or Shelikof Strait regions have not been captured in these regions and they cannot by identified as belonging to the Alaska breeding population, the Russian breeding population, or from both. If the latter, the proportions of the birds from the different wintering populations are unknown. In evaluating impacts, the Fish and Wildlife Service makes the assumption that the proportions in the wintering populations are equivalent to the proportions of Steller's eiders from the different breeding populations worldwide, which is that about 4% of the birds on the wintering grounds are from the Alaska breeding population. More specific information is provided in the following text.

There are data from various kinds of scientific investigations that provide a rough idea as to the numbers and distribution of Steller's eider in the lower Cook Inlet, Kachemak Bay, and in the Kodiak Archipelago.

Hundreds of Steller's eiders have been reported from aerial and boat bird and mammal surveys in nearshore areas of Kamishak Bay up to the Iniskin Peninsula (Arneson, 1980; Agler et al., 1995).

Bill Larned of the Fish and Wildlife Service has conducted opportunistic aerial surveys of Steller's eiders on the eastern side of Cook Inlet for the past several years while flying back to the Kenai Peninsula from areas further south. In the winters of 1997, 2001, and 2002 (January, February, or early March), he observed varying numbers (360-2,370) of Steller's eiders within 2-3 kilometers of shore over shoals in Cook Inlet between Deep Creek and the Homer Spit. Of the areas where Steller's eiders overwinter in lower Cook Inlet, the shallow, nearshore region just off of Deep Creek may represent especially high-quality (relative to other areas in the region near the multiple-sales area) overwintering feeding habitat for Steller's eiders, possibly due to high productivity associated with outflow from the creek (Larned, 2002, pers. commun.). During two separate surveys in 2001, large aggregations (800 versus 1500) were observed in this area. Other large aggregations have been observed just south of Ninilchik: in 1997 (650) and early March in 2001 (800) (Bill Larned, unpublished data) (see Figures III.B-4 and III.B-5). In comments on the draft of this Environmental Impact Statement, the Fish and Wildlife reported to the MMS that on 6 January, 2003, B. Larned surveyed the nearshore waters of eastern lower Cook Inlet and estimated 1,332 Steller's eiders off Deep Creek. While little information is available about Steller's eider use of the western side of Cook Inlet, it is not likely that there are large numbers of eiders along the west side north of Tuxedni Bay (Larned, 2002, pers. commun.).

Alaska Department of Fish and Game biologists have conducted winter waterfowl boat shoreline surveys and aerial surveys of offshore areas in Kachemak Bay (from Anchor Point to Point Pogibshi (bounded on the west by the 151°55′00″ longitudinal line) annually since 1999 (Petrula and Rosenberg, 2002). Both shoreline areas (defined as all waters within 200 meters of land) and offshore areas were surveyed. Offshore areas were stratified further according to bathymetry. Numbers of Steller's eiders observed and estimated are presented in Table III.B-10). Several points are noteworthy. The total numbers (all offshore strata plus onshore stratum) of Steller's eiders observed among years was highly variable, ranging from a low total of 38 in 2000 to a high of 286 in 2001 for an offshore aerial survey only (Petrula and Rosenberg, 2002). While no very large flocks were seen, areas of concentration were from the tip of the Homer Spit to approximately 5 kilometers west of Beluga Lake to and the region just south and east of Anchor Point (for example, see data for 2001 surveys in Figures III.B-4 and III.B-5). In 2 years (2001 and 2002), numerous eiders were observed in the less than 20-meter substratum of the offshore stratum (see data and figures in Petrula and Rosenberg, 2002). Based on this and on other sources (for example, Russ Oates, in litt., cited in 65 *FR* 13262; Agler, Kendall, and Irons, 1998), tens to hundreds of Steller's eiders frequently occur near Homer and the Homer Spit. Agler et al. (1995) also report hundreds of Steller's eiders along the south side of Kachemak Bay, especially between China Poot Bay and Point Bede.

Parts of the Kodiak Archipelago are used by thousands of Steller's eiders as wintering habitat. The entire coastline of Kodiak Island was included in the proposed critical habitat for Steller's eider, but it was removed from the final rule. Within the Kodiak Archipelago, there is considerable variation in the amount and quality of wintering habitat for Steller's eiders. The Fish and Wildlife Service concluded that this habitat heterogeneity may in part explain the lack of identified large aggregations near the archipelago (66 *FR* 8850). Dick (1977) and Forsell and Gould (1981) estimated from 1,000-2,000 wintered in the Kodiak Island area in the late 1970's. Based on aerial shoreline surveys conducted from January 29-February 2, 2001, of most of the eastern coastal portion of Kodiak Island and adjacent islands, including all habitats known to host significant numbers of wintering Steller's eiders, Larned and Zweifelhofer (2001) reported two estimates of abundance of Steller's eiders in the surveyed area. "The overall estimate this year was 4,196 without extrapolation" (Larned and Zweifelhofer, 2001:2) indicated a 27% decrease in abundance as compared to a comparable estimate in 1994 of 5,349. For 2001 they also derived a second "more accurate" estimate of 5,341 (not directly comparable to 1994). Densities of Steller's eiders in this area were low. Most eiders observed were in small flocks averaging 19 individuals with a range of 1-250 individuals observed in a "flock." The highest concentrations of eiders were observed in the southwest and west central sections of the Archipelago, including Sitkinak Strait, the passage between Sitkinak and Tugidak islands, Chiniak Bay and Narrow Cape, particularly in extensive eelgrass shoals and lagoons (Larned and Zweifelhofer, 2001). No Steller's eiders were observed in the Afognak/Shuyak area. The Fish and Wildlife Service (65 *FR* 13272) reported there was "…consistent and extensive use of the areas that have been surveyed in the Kodiak area…."

The degree of fidelity of wintering Steller's eiders to specific regions of the Kodiak Archipelago is unknown. Extreme disparities in distribution were noted between the 2001 survey and the comparable 1994 survey. Far fewer eiders were observed in the Akhiok and the immediate vicinity of Kodiak and none observed in Sitkinak Island Lagoon in 2001, but many more were observed in the pass between Sitkinak and Tugidak Islands (Larned and Zweifelhofer, 2001).

Information indicates that Steller's eiders make low and irregular use of Prince William Sound and the south side of the Kenai Peninsula. The Fish and Wildlife Service reports that 0-11 Steller's eiders per year have been observed (with none observed in 9 out of 12 years) on the south side of the Kenai Peninsula during sea duck surveys, and 0-68 per year have been seen (with none seen in 10 out of 20 years) in Prince William Sound (USDOI, Fish and Wildlife Service, 1998, cited in 66 *FR* 8850).

III.B.4.c(1)(h) Prey

As noted previously, Steller's eiders forage in shallow, nearshore areas. There are limited data available about prey consumed by Steller's eiders throughout their range. The Fish and Wildlife Service (1997b, cited in USDOI, NOAA, National Marine Fisheries Service, 2001) reported that primary foods in marine areas include bivalves, crustaceans, polychaete worms, and mollusks. A study of the diet of Steller's eiders in Nelson Lagoon from April-October 1977 and 1979 indicated that bivalves, especially blue mussels (*Mytilus edulis*) and clams (*Macoma balthica*), and gammarid and other amphipods were primary food items (Petersen, 1981).

III.B.4.c(1)(i) Survival

Flint et al. (2000) used mark-recapture analyses to estimate annual survival of birds captured and marked at molting sites at Izembek and Nelson Lagoons between 1975 and 1997. Estimated annual survival for females and males was 0.899 ± 0.032 for females and 0.765 ± 0.044 for males. The higher survival of females is unusual for waterfowl, and Flint et al. (2000) speculate that a shortage of males currently may be limiting reproductive potential. Flint et al. (2000) concluded that the best model for their data was one in which survival has declined over time. However, the evidence for this conclusion is, by their own admission, weak (Flint et al., 2000).

III.B.4.c(1(j) *Identified Threat*

The cause(s) of the decline of nesting Steller's eiders in Alaska are not clear (Quakenbush and Suydam, 1999; UDOI, Fish and Wildlife Service, 2002). Based on theoretical considerations, Flint et al. (2000) hypothesized that a reduction in female survival initiated the decline. There is little information about survival or recruitment in this species (Flint et al., 2000). Poisoning from lead shot may have been a primary or contributing cause. Other potential contributing factors identified in the listing rule (62 *FR* 31748) included changes in the numbers or diets of predators, such as gulls, foxes, ravens, or other predators; hunting (via direct take or resulting in lead shot contamination of habitat); and unknown and undocumented changes to wintering and molting areas due to large scale changes in the Bering Sea (66 *FR* 8850). Both snowy owls and pomarine jaegers can prey on eider eggs, chicks, and sometimes, adults (Quakenbush and Suydam, 1999). Other potential threats, including exposure to oil and other contaminants near fish-processing facilities in southwestern Alaska, subsequently have been identified (UDOI, Fish and Wildlife Service, 2002). Predation, human harvest, injury, and oil spills are known sources of Steller's eider mortality (USDOI, Fish and Wildlife Service, 1998). Historic known takes included subsistence and sport hunting, but Quakenbush and Suydam (1999) reported that there is not available evidence that overharvest led to the decline. Evaluation of the reliability of estimates of previous and any existing harvest levels is not available.

The Fish and Wildlife Service concluded (66 *FR* 8853) that there is no evidence that habitat loss and disturbance have played important roles in the decline of the species in Alaska, because "(1) only a very small proportion of the species vast and remote habitat in Alaska has been modified by humans; (2) other waterfowl species continue to occur or nest in large numbers in…areas with human…impact; and (3) the only place…the Steller's eider is currently known to regularly nest in Alaska is near Barrow, where they nest near gas pipelines, roads, airports, and other…human disturbance and habitat modification." The Fish and Wildlife Service (2002) reiterated this basic conclusion in their most recent Draft Steller's Eider Recovery Plan. They point out, however, that localized developments in Steller's eider habitat may impede their recovery. The National Marine Fisheries Service (2002b) reported that within the marine range of the Steller's eider, the marine environment likely has been affected by human activities including commercial fishing, marine transport, and environmental pollutants. They also reported that Steller's eiders possibly could be threatened by changes in prey availability associated with ecosystem change in the Bering Sea. Quakenbush and Suydam (1999) report that small housing developments near Barrow pose a threat to some nesting habitat.

III.B.4.c(2) Short-tailed Albatross (*Phoebastria albatrus*) (formerly *Diomedea albatrus*) – Endangered

III.B.4.c(2)(a) *Summary*

Short-tailed albatross are an endangered, large, highly pelagic seabird that currently is known to successfully nest only on three islands in the western North Pacific and that spends most of its life at sea within a vast marine area used for foraging. Areas of the Gulf of Alaska near the proposed multiple-sales area are part of this vast, but poorly defined, marine foraging area that encompasses much of the North Pacific Ocean. Sighting data do not indicate that either Cook Inlet or Shelikof Strait is part of the typical range of this species. The numbers of this species currently are low, but survival is high and populations are increasing. The long-term survival of the species is highly vulnerable to catastrophic destruction of their primary nesting colony. The volcano on which this colony exists erupted for several days in mid-August, heightening concerns for the future viability of this species. There is no information indicating that albatross nesting habitat was damaged. By early September, the volcano was once again quiet. They also are threatened by mortality associated with longline fisheries, by potential mortality due to oil spills and plastic debris, and by factors associated with there being only two viable, but very small, populations. This species' Oil Vulnerability Index score was the highest of all species of birds evaluated.

III.B.4.c(2)(b) *General Description*

Short-tailed albatross, also known by other names including the coastal albatross, and in Japan as ahodori (Steiner, 1998), are the largest seabird in the Northern Hemisphere, with a 2.4-meter (8-foot) wingspan and a 7-kilogram (15-pound) body (Steiner, 1998). They are pelagic seabirds, one of four albatross species (also the Laysan, black-footed, and waved albatross) in the genus *Phoebastria.* Their bones are strong but lightweight. Like other albatross, this species has evolved an amazingly efficient flight called dynamic soaring, which permits them to travel very great distances over the ocean, often soaring right above the surface of the sea (65 *FR* 46643).

III.B.4.c(2)(c) Current Protected Status

The short-tailed albatross was declared endangered by the International Council for Bird Conservation in the 1960's, and was listed as endangered under the Endangered Species Conservation Act of 1969. It was listed as endangered throughout it range, except in the United States (50 CFR 17.11), under the ESA in 1974. The short-tailed albatross appeared only on the List of Endangered Foreign Wildlife. However, due to issues regarding resident status, the short-tailed albatross in the United States was not formally proposed for listing pursuant to the criteria and procedures of the ESA until 1979. On July 31, 2000, the Fish and Wildlife Service published a final rule to list short-tailed albatross as endangered under the Endangered Species Act the United States, correcting an oversight recognized in 1979. This species is also protected by additional state, national, and international legislation (see references and discussion in the Final Rule to List document [65 *FR* 46643]).

Critical habitat has not been designated for this species. In the 1998 proposed rule to list the short-tailed albatross as endangered under the ESA, the Fish and Wildlife Service concluded that with respect to potential nesting habitat within the United States designation was not prudent, because there would be no additional protection or benefit afforded critical habitat at Midway Atoll over that conferred through the jeopardy standard. Regarding marine foraging areas within the United States, the Fish and Wildlife Service concluded that "…there would be no additional benefit because there is no information to support a conclusion that any specific marine habitat area within United states jurisdiction are uniquely important…the proposed rule also concluded that there would be no additional benefit or protection conferred through the destruction or adverse modification standard…. Furthermore, there were no areas that we could identify as meeting the definition of critical habitat" (65 *FR* 46651-46652).

The short-tailed albatross is classified as endangered by the State of Alaska (State of Alaska, Alaska Statutes, Article 4. Section 16.20.19) but is not on the State of Hawaii's list of threatened and endangered species (65 *FR* 46643).

To reduce the bycatch and incidental mortality of short-tailed albatross and other seabirds (62 *FR* 23176) in hook-and-line fisheries, the National Marine Fisheries Service promulgated regulations on April 29, 1997, requiring fishermen using hook and line to fish for groundfish in the Bering Sea, Aleutian Islands, and the Gulf of Alaska, and federally permitted hook-and-line vessel fishing for groundfish in Alaska waters adjacent to the Bering Sea, Aleutian Islands, and the Gulf of Alaska, to employ specified seabird avoidance measures. In 1998, the National Marine Fisheries Service required seabird-avoidance measures to be used by fishermen fishing for halibut in U.S. Convention waters off of Alaska (63 *FR* 11161). In April 1999, the North Pacific Fishery Management Council approved revised and additional seabird avoidance measures for the Pacific halibut hook and groundfish hook-and-line fisheries off of Alaska. The National Marine Fisheries Service has postponed rulemaking on the revised measures pending analysis and review of research aimed at evaluating the effectiveness of various seabird avoidance techniques (National Marine Fisheries Service, Alaska Regional Office web page on Incidental Take of Seabirds, June 2002). On March 15, 2000, the National Marine Fisheries Service and the Fish and Wildlife Service signed an agreement to provide funds to help longliners install seabird-deterrent devices on boats fishing the Bering Sea and North Pacific (USDOI, Fish and Wildlife Service, 2000b).

III.B.4.c(2)(d) Available Information about Distribution, Abundance, and Habitat Use

Albatross are seabirds and, as such, spend the majority of their life at sea. Their distribution can be partitioned into land areas used for nesting and their distribution while at sea. Information about the locations of current nesting colonies probably is relatively complete. Information available about historical breeding locations is incomplete, about historical nonbreeding distribution is scant (63 *FR* 58693), and about current patterns of marine habitat use is incomplete and probably biased.

III.B.4.c(2)(e) Pre-Exploitation

Historically, short-tailed albatross likely were common in many marine areas throughout most of the North Pacific Ocean (from Alaska to Baja California), the Bering Sea, the Sea of Okhotsk, the Sea of Japan, and off of China (McDermond and Morgan, 1993; USDOI, Fish and Wildlife Service, 1998b; 65 *FR* 46643). Evidence from middens suggests that the short-tailed albatross was abundant in nearshore areas from California to St. Lawrence Island up to 4,000 years ago (Howard and Dodson, 1933; Yesner and Aigner, 1976). They were reported to be numerous or abundant in areas such as the Bering Sea, parts of the Aleutian Islands (Yesner, 1976), around Cape Newenham in western Alaska (DeGange, 1981), near the Pribilofs (Gabrielson and Lincoln, 1959), and on the west coast of Vancouver Island (Kermode, cited in Campbell et al., 1990).

There were at least 14 known nesting colonies on individual islands in the following island groups: the Seven Islands of Izu Group of Japan (Torishima), the Bonin Islands of Japan, the Diaito group of Japan, the Ryukyu Islands of Japan, the western Volcanic Islands of Japan, and islands off of Taiwan (King, 1981; 65 *FR* 46643). Other nesting colonies may have existed (for example, on the islets within Midway Atoll) (65 *FR* 46643).

There is no definitive evidence available confirming that this species has ever bred in Alaska, but there is uncertainty about this issue. Some naturalists (for example, Turner and Chamisso, cited in Yesner, 1976) believed that this species may have bred in the Aleutian Islands. High numbers of short-tailed albatross were observed offshore of the Aleutian Islands during summer and fall (Yesner, 1976). Aleut lore referred to locally breeding birds of this species (65 *FR* 46643). However, because only adult, but not juvenile, bones are found in Aleut middens, Yesner (1976) concluded they did not breed in the Aleutians. After consideration of the known locations where winter breeding occurs and the constraints that would be placed on birds breeding in the winter at high latitudes (65 *FR* 46643), Sherburne (1993) concluded that it is unlikely that this species ever bred in Alaska. There is no available evidence that the short-tailed albatross ever nested in areas within or near the proposed Cook Inlet multiple-sales area.

Historical and recent evidence indicates that short-tailed albatross nest on isolated, windswept island in areas often with restricted human access, on flat or sloped sites, and in sparse or full vegetation (Aronoff, 1960; Sherburne, 1993; DeGange, 1981; USDOI, Fish and Wildlife Service, 1999).

Hunting of short-tailed albatross at their breeding colonies for feathers, meat, fat, and eggs (Austin, 1949) began in the late 1880's (for example, at 1887 at Torishima), continued into the 20th century, and led to their near extinction. Reliable total estimates of the number of short-tailed albatross prior to commercial hunting are unavailable (65 *FR* 46643), because there is apparently little or no information available about abundance at many of the historic breeding colonies. Steiner (1998) reports that in 1899, feathers from more than 260,000 albatross were collected from Torishima. Y. Yamashina (cited in Austin, 1949 and Steiner, 1998) estimated that at least 5 million albatross were killed between 1887 and 1902. Harvest continued into the 1930's. In the 1930's (Steiner, 1998; 65 *FR* 46644), villagers slaughtered about 3,000 birds. The species was believed extinct in 1949 and there were no known breeding pairs at any historic breeding colony (Austin, 1949). The next year (1950), however, nesting was confirmed on Torishima (Tickell, 1973, 1975). At few as 30-50 birds may have survived, presumably juveniles or other nonbreeders that were away at sea during the last years of the last slaughter. Between 1950 and 1977, the population at Torishima increased at an average of 2.5 adults per year and between 1978 and 1991 at an average of 11 adults per year.

III.B.4.c(2)(f) Current Nesting Distribution and Recent Population Size and Trend

At present, short-tailed albatross are confirmed to nest successfully on three islands in Japan: Torishima in the Seven Islands of Izu Groups; Minami-kojima (65 *FR* 46643) in the Senaku Islands; and just during the last breeding season, on Kita-Kojima (Hasegawa, 2002, pers. commun.) also in the Senkaku Islands near Taiwan. Both Torishima and Minami-kojima were historical nesting sites (65 *FR* 46643). Attempts are under way to establish a second breeding colony on Torishima, on the other side of the island from the location of the existing colony. Short-tailed albatross also have been observed on Midway Atoll since at least the 1930's. A pair may have nested successfully at Midway in 1961 and 1962, but this report is unconfirmed (65 *FR* 46643). At least one female, banded as a chick at Torishima in 1982, laid and incubated an inviable egg on Sand Islet in each of three different, nonsuccessive years.

Abundance at the two main breeding colonies is increasing, and there is no indication that availability of prey is limiting population growth. Due to average annual growth rates that have been as high as 6% per year (Hasegawa, 1982; Cochrane and Starfield, In prep., cited in 63 *FR* 58692, and recent growth rates of about 7.8% (Cochrane and Starfield cited in 65 *FR* 46643), the population at Torishima has increased gradually since 1950 and should continue to increase barring catastrophic destruction (for example, the eruption of the volcano) (Hasegawa, 1997). Nesting sites currently are not limiting.

Current knowledge of population abundance is based on information collected by H. Hasegawa from studies at the known breeding locations during the 2001-2002 nesting season. In the 2001-2002 breeding season, 251 eggs were observed on Torishima, and Hasegawa estimates that the size of the Torishima population, including fledged young, would be about 1,415 birds. Since the 1997-1998 breeding season, more than 130 young have fledged annually from Torishima, and Hasegawa expects that the breeding population will begin to increase rapidly beginning in the 2004-2005 breeding season. Hasegawa estimates the size of the breeding population on Minami-kojima at about 50-55 breeding pairs with a total population of about 200-250 birds. One chick successfully fledged from Kita-Kojima, indicating that the range of the short-tailed albatross in the Senaku Islands is expanding.

Based on comparison of the current estimates and previous estimates, the populations are steadily increasing. In 1951, there were an estimated 10 adults on Torishima (Cochrane and Starfield, 1999). In 1998, H, Hasegawa (cited in Steiner, 1998) counted 194 breeding pairs (388 individuals) and 130 chicks on Torishima. Based on the number of eggs counted (212 versus 251in 2001-2001), there were 424 breeding adults on Torishima during the 1998-1999 breeding season. In 1991, Hasegawa (1991) estimated the population on Minami-Kojima to be 75 individuals with 15 breeding pairs. Ten chicks were observed. In 1998-1999, the estimate for that breeding colony was 150 birds and 30 breeding pairs (H. Hasegawa, cited in 65 *FR* 46643).

In 1998-1999, the total estimated number of short-tailed albatross breeding in that year was 484, with 424 on Torishima and 60 (the 30 pairs) on Minami-kojima (Hasegawa, cited in 65 *FR* 46643). The reliability of current estimates of the numbers of nonbreeding short-tailed albatross is unknown. Based on evidence that indicates about 25% of birds of breeding age do not breed in any given year, it was estimated that in 1999 there were about 600 nonbreeding birds of this species worldwide (65 *FR* 46643). In 1999, the total estimate for the species, including at-sea juveniles, nonbreeding birds on Torishima, breeding pairs, and those on Minami-kojima was thought to be about 1,200 birds. The reliability of this total estimate is unknown because of uncertainty about the at-sea portion of the population.

III.B.4.c(2)(g) Current Nonbreeding Marine Distribution

Available information that short-tailed albatross are not likely to be present within the proposed multiple-sales area, are widely scattered at low density throughout shelf-break areas in adjacent regions of the Gulf of Alaska, and that subadult birds are much more likely to be present in these areas than are adults.

There is relatively little specific information about the postbreeding movement patterns or marine distribution of this species (McDermond and Morgan, 1993) except that it is clear that they are highly mobile, capable of long-distance travel, and that the potential marine habitat used is vast. Sightings, especially before the 1980's, are few compared to the vastness of the total potential range of the species. With regard to areas where they are seen, the Fish and Wildlife Service summarizes (65 *FR* 46646) that the short-tailed albatross "…is distributed widely throughout its historic foraging range of the temperate and subarctic North Pacific Ocean (Sanger 1972 unpublished data) and is often found close to the U.S. coast….)" (65 *FR* 44646). There are many observations of individuals within 10 kilometers (6 miles) and several within 5 kilometers (3 miles) of the coast (T. Antrobus, UDOI, Fish and Wildlife Service, cited in 65 *FR* 46643; J. Michaelson, cited in USDOI, Fish and Wildlife Service, 1999 biol. Opin.). The Fish and Wildlife Service (1999) reports that their presence may coincide with areas of high productivity. Observations indicate that older albatross tend to be present in the Gulf of Alaska coastal break regions during summer and fall, whereas subadult individuals can be present anytime (National Marine Fisheries Service, 2002). Areas of relatively frequent sightings include coastal shelf-break areas in the Bering Sea, Northern Gulf of Alaska, and The Aleutian Islands. The Fish and Wildlife Service (65 *FR* 46647) summarizes that marine areas known to be used by short-tailed albatross are characterized by "…coastal regions of upwelling and high productivity and expansive, deep water beyond the continental shelf." They concluded (65 *FR* 46647) that the relative use and importance of coastal shelf-break areas versus open ocean to the species is unknown.

The uncertainty about habitat use stems from the fact that much of what is known about the at-sea distribution of the short-tailed albatross since 1900 is based on a database of short-tailed albatross sightings maintained by the Fish and Wildlife Service, which contains more than a thousand sighting records between 1905 and late October 2001. While these data are useful for indicating locations where birds were seen, it is difficult to draw conclusions about overall albatross distribution over their entire potential range. This is because there are temporal, spatial, and numerical biases in the data due to factors such as observer effort, area covered, and number of vessels, in addition to increased awareness resulting from new regulations and government outreach efforts. Thus, data from different time periods may not be comparable, and the areas of sighting may be biased by unequal distribution of vessel and observers. For example, the distribution of the birds may appear to be coastal, because the distribution of boats from which they are typically observed are relatively coastal. There is relatively little observer possibility in the open ocean. Thus, the data provide a biased view of overall distribution, because the distribution of the boats (generally) from which they were observed is biased towards coastal areas.

Map 15 shows sightings of short-tailed albatross between 1905 and 1996. Recently, short-tailed albatross have been seen most frequently around the western Aleutian Islands and the Pribilof Islands. In those records in which age was recorded, four times more nonadults (juveniles, immatures, and subadults) were sighted than adults. Most (greater than 90%) of the recorded sightings were of one (mostly) or two individuals seen at all times of the year. In U.S. waters, aggregations of more than five individuals are rarely seen. One aggregation of up to 40 individuals has been reported since 1905.

III.B.4.c(2)(h) Use of Areas Within or Near the Cook Inlet Multiple-Sales Area

The intensity of use of specific areas, including areas near the proposed lease sales area, is not well defined. The best available information indicates that each individual albatross in the world population could occur anywhere within the species marine range (USDOI, Fish and Wildlife Service, 1999), including the areas adjacent to the proposed multiple-sales area. Based on the current sighting database, short-tailed albatross have not been observed between 1906 and the present within the proposed lease sales area. There is no nesting within thousands of miles. However, there have been two observations of short-tailed albatross on the west side of Kodiak Island, and there have been numerous observations south of Kodiak Island and the Kenai Peninsula and along the Alaska Peninsula (see Map 15). Within the United States, excluding Midway Atoll west of the northwest Hawaiian Islands, short-tailed albatross habitat is entirely marine habitat used for foraging. These areas are vast, and individual short-tailed albatross are widely scattered throughout the range. The Fish and Wildlife Service (65 *FR* 46647) summarizes that the species uses coastal shelf-break areas in areas including the Gulf of Alaska, but that "…it is not known how important these areas are to the species…or if it uses open ocean areas to the same degree."

III.B.4.c(2)(i) Relevant Life-History Characteristics

Short-tailed albatross are slow to mature and are long lived. Current evidence indicates they generally first breed at 6 years of age (Hasegawa, cited in Cochrane and Starfield, 1999) and may live to be 50 or more years old (Hasegawa, cited in Cochrane an Starfield, 1999). At present, postfledging survival is high, with an estimated 96% average annual survival rate (Hasegawa, cited in Cochrane and Starfield, 1999). They are monogamous, breeding-site fidelity is high, and birds that lose a mate may require 2 years or more to form a new bond and nest again Hasegawa, cited in Cochrane and Starfield, 1999). They have a low reproductive rate. In a given year, a female lays one egg. Up to 25% of breeding-age adults may not return to the breeding colony in a given year (Hasegawa, (cited in 65 *FR* 46643; Cochrane and Starfield, cited in 63 *FR* 58692). Breeding is fairly synchronous. At Torishima, albatross return in October to breed (Steiner, 1998) and egg laying continues through late November. Incubation is long, lasting slightly more than 2 months (about 64-65 days). Both the synchrony of reproduction and the long length of nestling dependence make the population relatively vulnerable to local perturbation. Hatching occurs at Torishima in late December through early January (Hasegawa and DeGange, 1982).

Males and females alternate incubating and foraging. It is not clear where nesting birds forage. Observed distribution is concentrated near breeding colonies during December-April (McDermond and Morgan, 1992).

About 60-70% of eggs laid results in a fledged chick (Hasegawa, cited in 65 *FR* 46643). Breeding success can be negatively impacted by events such as typhoons, mudslides, and volcanic eruptions. Evidence indicates that the current rate of survival between fledging and the age of first reproduction is about 94% (Cochrane and Starfield, cited in 65 *FR* 46643). Adults generally leave the colony by late May to early June, and fledglings become independent (Hasegawa, cited in 65 *FR* 46643). By mid-July, all birds have left the colony (Austin, 1949).

After fledging, short-tailed albatross spend at first 2-5 years at sea (Hasegawa and DeGange, 1982). Information about postfledging movements and the typical degree of fidelity by males and females to the birth site as a future breeding site is uncertain at present, partially because of the unsaturated nature of the current breeding locations. At present, most short-tailed albatross return to the breeding colony of their birth to breed and return to the same breeding location for subsequent nesting attempts. However, a few individuals do attempt to breed at sites other than those at which they were born (Hasegawa, cited in 65 *FR* 46643; Richardson, 1994), suggesting that recolonization of other historic breeding sites could someday occur. At least four individuals banded as chicks on Torishima and one banded in "Japan" (location unspecified) traveled to Midway as adults. In some cases these individuals repeatedly returned during the breeding season, and one laid three eggs that never hatched (65 *FR* 46645).

Albatross are sensitive to changes in adult survival because they have a low reproductive rate, relatively long lifespan, delayed sexual maturity, and typically low annual adult mortality (Cochrane and Starfield, 1999).

Full adult plumage is attained by 12 years of age

III.B.4.c(2)(j) Foraging Ecology and Prey

Information on the foraging ecology and the diet of this species is limited, being based primarily on food taken by breeding birds from Torishima and on observations of birds at sea. The extent to which diet varied historically by breeding colony or varies currently due to season, environmental conditions and/or habitat is unknown (65 *FR* 46643). This species is thought to use high-productivity coastal shelf breaks for foraging (65 *FR* 46643). Known prey includes squid, fish, eggs of flying fish, shrimp and other crustaceans (Hattori, cited in Austin, 1949; Hasegawa, cited in 65 *FR* 46643). Short-tailed albatross chicks are fed a regurgitated mixture of fish and squid (Steiner, 1998).

III.B.4.c(2)(k) Conservation Issues

III.B.4.c(2)(k)1) General

The Fish and Wildlife Service has identified the following actions that may require ESA conference or consultation due to the potential for such actions to affect the short-tailed albatross: the National Marine Fisheries Service Fishery Management Plans; management practices at Midway Atoll National Wildlife Refuge; permits or authorization for oil tankering within the range of this species; and oil-spill-contingency plans (65 *FR* 46643).

Cochrane and Starfield (1999) identify both volcanic eruption and oil spills near the nesting grounds as potential risk factors to the short-tailed albatross. Important adverse impacts on the Laysan albatross have been documented from factors including incidental fishery take and environmental contamination (Ludvig et al., 1998). Cochrane and Starfield also identify the ingestion of waste plastics picked up at sea as a factor that could cause increasing, adverse impacts on albatross. Factors that can negatively impact seabirds in general include oil and fuel spills and fishing-gear entanglement.

III.B.4.c(2)(k)2) Threats to Breeding Habitat

The most significant threat to the long-term recovery and continued existence of Short-tailed albatross is the potential of habitat destruction due to volcanic eruption on the main extant breeding island of Torishima (an active volcano), which could cause significant mortality of adults and chicks, as well as destroy nesting habitat. On August 11, 2002, Torishima began actively erupting but became quiet after several days. However, resident short-tailed albatross were at sea at the time of the eruption and will not return to the island until October (see the previous discussion). Eruptions in 1902 and 1939 destroyed much of the original breeding habitat (65 *FR* 46644). Ten years after the 1939 eruption, Austin (1949) reported that the thick reed that formerly sheltered the albatross colony were gone, with almost the entire island covered in lava. The risk of extinction of the entire colony is lessened because of the existence of immature and nonbreeding birds that are away from the breeding colonies and at sea. However, another eruption also would destroy nesting habitat and could result in further loss of genetic variability, increasing the long-term risk of extinction of this species.

Short-tailed albatross also are negatively impacted by adverse weather during nesting. Rain associated with monsoons and typhoons can cause mudslides and erosion, which could kill individuals and destroy breeding habitat at Torishima (65 *FR* 46644). Erosion control on Torishima and attempts to establish a second breeding colony on the island are efforts being taken to improve long-term population viability.

III.B.4.c(2)(k)3) Predation and Purposeful Take

There is no evidence that predation by any species currently is having a significant impact on the recovery of the short-tailed albatross. However, data are essentially nonexistent for the possible role of predation in the marine environment.

Predation is a risk to, but not currently a factor, at, breeding colonies. Both black rats and cats were introduced to Torishima. In the case of rats, their impact on albatross is unknown. While cat presence was documented in the 1970's, Hasegawa (1982) did not find evidence of cats on the island. Shark predation of fledglings is an important source of mortality in other albatross species, and sharks may take fledgling short-tailed albatross. However, estimates of the current rates of survival to breeding age are high, and there is no documentation of shark predation of the short-tailed albatross. Crows (*Corvus sp.*) historically took albatross chicks on Torishima (Hattori, cited in Austin, 1949), but there currently are no crows on the island (Hasegawa, cited in USDOI, Fish and Wildlife Service, 1999).

Local Japanese fishermen hunting seabirds (Hasegawa, cited in 65 *FR* 46644) occasionally might take short-tailed albatross. No other direct take is known to occur. No take by Alaska Natives is documented.

III.B.4.c(2)(k)4) Diseases and Parasites

No diseases currently are known to affect this species, but chicks of other species of albatross on Midway Atoll have been affected by an avian pox (65 *FR* 46644). There is no current evidence of parasites on Torishima or evidence of population-level effects from parasites reported in the past (Hasegawa, cited in 65 *FR* 46644). However, parasites have been historically documented on short-tailed albatross on Torishima: a feather louse, a blood sucking tick, and a carnivorous beetle (Austin, 1949).

III.B.4.c(2)(k)5) Fisheries Interactions

The Fish and Wildlife Service (1999) concluded that longline fisheries in the Bering Sea and North Pacific Ocean pose a risk to short-tailed albatross. Seabirds can be negatively impacted by groundfish fisheries through incidental take in gear. Seabirds, including albatross, are attracted to the bait on longline hooks and, when they attempt to take the bait they become hooked and are pulled underwater and drown (USDOI, Fish and Wildlife Service, 1999; Rivera and Wohl, 1999). It was the documentation of extremely high levels of mortality of other species of albatross (44,000/year or average catch rate of 0.41 birds/1,000 hooks) in longline fisheries in southern oceans (Brothers, 1991) that spurred implementation of seabird bycatch measures by the CCAMLR in 1992 (Rivera and Wohl, 1999). The majority of take of short-tailed albatross in Alaskan groundfish fisheries occurs in longline gear. In Russian waters, short-tailed albatross are sometimes taken in an offshore driftnet fishery (Steiner, 1998). The Fish and Wildlife Service has concluded that fishing activities other than hook and line longline fishing in Alaska and Hawaii are not likely to take this species. There have not been reported takes of short-tailed albatross in pelagic longline fisheries in the vicinity of the Hawaiian Islands, but unreported take may occur (E. Flint, cited in USDOI, Fish and Wildlife Service, 1999). In 1996, both black-footed (1,189) and Laysan (625) albatross were taken in the fishery (Food and Agriculture Organization of the United Nations, 1998; USDOI, Fish and Wildlife Service, 1999). The vast majority of longline fisheries remain unregulated and unmonitored and there is very little information available about the impact of foreign fisheries on this species (USDOI, Fish and Wildlife Service, 1999).

Estimates of the numbers of seabirds taken incidental to fisheries in Alaska are based on observer reports of the number of birds taken in observed sets, total fish catch, vessel effort (i.e., the number of hooks) for observed and unobserved sets, seabirds distribution, etc. (Rivera and Wohl, 1999). In the 1980's, two short-tailed albatross were killed in fishing-related activities in Alaska, one in a fish net north of St. Matthew Island and one incidental to halibut fishing in the Gulf of Alaska. Since 1990, five short-tailed albatross have been taken in fisheries in Alaska (USDOI, Fish and Wildlife Service, 1999). Three short-tailed albatross were taken between 1993 and 1999. The Fish and Wildlife Service (1999) concluded that the best available information indicated that two birds per year were taken in the Gulf of Alaska and Bering Sea/Aleutian Island hook-and-line fisheries in that 6-year period. The Fish and Wildlife Service also concluded that take in the commercial halibut longline fishery in U.S. waters off Alaska within the International Pacific Halibut Commission regulatory zones 2B, 2C, 3A, 3B, 4A, 4B, 4C, 4D, and 4E is likely to adversely affect, but not jeopardize, short-tailed albatross. After using computerized simulations to evaluate the possible effects of incidental take in fisheries on the short-tailed albatross population on Torishima, Cochrane and Starfield (1999) concluded that documented levels of incidental take of short-tailed albatross (using the value of 0.5% take/year) were having a modest impact on population increase (for example, a 6% increase in recovery time). Between 1983 and 1998, six out of seven short-tailed albatross reported taken incidental to fisheries in Alaska were less that 6 years old (Cochrane and Starfield, 1999). The Fish and Wildlife Service has been providing seabird-deterrent devices to longline fishing vessels in Alaska to attempt to reduce take associated with these fisheries (USDOI, Fish and Wildlife Service, 2000b).

As noted before, the Fish and Wildlife Service has concluded that, with regards to foraging areas within the United States:

> …there is no information to support a conclusion that any specific marine habitat area within United [S]tates jurisdiction are uniquely important…the proposed rule also concluded that there would be no additional benefit or protection conferred through the destruction or adverse modification standard…Furthermore, there were no areas that we could identify as meeting the definition of critical habitat (65 *FR* 46644).

Cochrane and Starfield (1999) pointed out that the impact of incidental take could pose threats to the short-tailed albatross not currently identified, if severe population reduction occurred due to some catastrophic event at the major breeding colonies or if fecundity or survival rates were significantly negatively impacted by some other factor. The same is true for the analyses presented here. However, based on current population status and trends, the Proposed Action is not likely to have significant adverse effects on the short-tailed albatross.

III.B.4.c(3) Aleutian Canada Goose (*Branta canadensis leucopareia*) – Delisted 2001

III.B.4.c(3)(a) Summary and General Description

The Aleutian Canada goose is a diminutive subspecies of Canada goose that is typically distinguishable (past its first winter) from other subspecies of Canada geese by a combination of characters including a distinct white neck ring at the base of a black coat and other more subtle differences. It currently breeds on islands primarily in the western Aleutians, but historically it nested on islands much further east, including islands near Kodiak Island (66 *FR* 15643). This subspecies was nearly extirpated primarily due to the introduction of the fox to its breeding islands. Currently, the population in the western Aleutians is increasing rapidly, and overall numbers far exceed abundance criteria set by the recovery team. Aleutian Canada geese in the central Aleutians have not recovered in numbers, and the population breeding in the Semidi Islands has not increased to expectations. This species did not, and does not currently, nest within the proposed multiple-sales area. The sales area is not part of the normal migration range of this subspecies (Byrd, 2002, pers. commun.).

For details that are outside the scope of the current document, we refer readers to the Aleutian Canada Goose Recovery Plan (USDOI, Fish and Wildlife Service, 1991), the review by Byrd (1998), and the Final

Rule to Remove the Aleutian Canada Goose from the list of threatened and endangered wildlife (66 *FR* 15643).

III.B.4.c(3)(b) Current and Past Protective Status

The Aleutian Canada goose currently is not listed under the ESA. It was removed from the Federal Government's list of endangered and threatened wildlife on March 20, 2001 (66 *FR* 15643). The Fish and Wildlife Service in the second year of a 5-year monitoring period required under Section 4(g)(1) of the ESA for all species following delisting. At the end of the 5-year period, the Fish and Wildlife Service will, based on the information obtained from monitoring, decide if the subspecies should be relisted under the ESA, if monitoring should be continued, or if monitoring will be curtailed (66 *FR* 15643). In the Final Rule to remove the protective ESA for the Aleutian Canada Goose, the Fish and Wildlife Service stated that they intend to continue yearly monitoring of the status of those geese associated with the Semidi Islands beyond the required 5-year period. If information indicates that a reversal of recent recovery has occurred, the Fish and Wildlife Service will conduct a status review of this species. The Aleutian Canada goose continues to be covered by provisions of existing Habitat Conservation Plans issued under Section 10(a)(1)(B) of the ESA. It also continues to be protected under provisions of the Migratory Bird Treaty Act. The Aleutian Canada goose is listed by the state of Alaska as a Species of Special Concern.

The Aleutian Canada goose was first designated as an endangered species in the United States in 1967 (32 *FR* 4001) under the Endangered Species Preservation Act of 1969; it was included in 1970 on the foreign species list of the Endangered Species Conservation Act of 1969, and under the ESA in 1973. A recovery plan was approved in 1979 and revised in 1982 and 1991 (USDOI, Fish and Wildlife Service, 1991). The ESA status of the Aleutian Canada goose was reclassified from endangered to threatened in 1991 (55 *FR* 51106).

III.B.4.c(3)(c) Population Structure

Microsatellite and mitochondrial DNA frequency data support the taxonomic distinction of Aleutian Canada geese and the cackling Canada goose (Shields and Wilson, 1987; Pierson, Pearce, and Talbot, 2000). Geese on the Semedi Islands have slightly less vivid plumage characteristics than other Aleutian Canada geese, but genetic studies indicate both Chugulak and Semedi Island geese are more closely related to other Aleutian Canada geese than to other subspecies (Schields and Wilson, 1987; Pierson, Pearce, and Talbot, 2000). However, analyses of both mitochondrial DNA haplotype and microsatellite allele frequencies indicated that there is little, if any, gene flow between geese breeding on Buildir Island and those breeding on the Semidi Islands. Pierson, Pearce, and Talbot (2000:172) concluded that that the "…degree of population genetic differentiation suggest that Aleutian Canada goose populations could be considered separate management units."

III.B.4.c(3)(d) Current Population Status

The Fish and Wildlife Service (66 *FR* 15653:15654) has concluded that "…the population Aleutian Canada goose in North America has recovered…," primarily due to removal of foxes from nesting islands, release of captive-reared and wild translocated geese to fox-free islands, protection of the geese from hunting and disease throughout its range, and protection and management of migration and wintering habitat. The overall abundance of Aleutian Canada geese has increased dramatically (see the following discussion,, and the breeding range has expanded. The small group of geese nesting on Chagulak Island is believed to be stable, whereas initially increased in abundance, has had a lack of increase since 1993 and lower productivity than geese nesting in the western Aleutians (Beyersdorf and Pfaff, 1995).

III.B.4.c(3)(e) Historic and Current Distribution and Abundance

The range of this subspecies once included both North America and Asia (Amaral, 1985). Its nesting range historically extended from the northern Kuril and Commander islands, east through the Aleutian Islands to islands south of the Alaska Peninsula and near to Kodiak Island (see USDOI, Fish and Wildlife Service, 1991:Figure 1; 66 *FR* 15643). It overwintered in Japan and in coastal states of the United States and into Mexico.

Following the introduction of foxes to more than 190 nesting islands between 1750 and 1936, this species declined rapidly. Hunting and habitat loss on migration routes contributed to the decline.

When first listed as endangered in 1967, the species was thought to breed only on Buildir Island in the western Aleutians (Jones, 1963). Kenyon (1963) speculated that only 200-300 birds remained on Buildir Island. In 1975, 700 individuals were counted near Crescent City, California (Springer, Byrd, and Woolington, 1978). Small breeding groups were found on an island in the Semidi Islands in 1979 (Hatch and Hatch, 1983b) and in the central Aleutians in 1982 (Bailey and Trapp, 1984).

Currently, the Aleutian Canada goose nests on primarily on Buildir Island (an estimated 7,000 breeders and an estimated 17,500 total birds in 1995) (66 *FR* 15643); on Agattu Island, (an estimated 700 breeding and 1,750 total geese in 1995); on Alaid-Nizki Islands (an estimated 248 breeding and 620 total birds in 1995); on Chagulak Island (about 20-25 breeding pairs); and in the central Aleutians on the Semidi Islands south of the Alaska Peninsula (about 120 individuals). A small number of geese are also breeding on Amchitka, Amukta, and Little Kiska Islands (66 *FR* 15643).

The Fish and Wildlife Service (Biological Opinion in USDOI, MMS, Alaska OCS Region, 1995) summarized that “The migration route to and from wintering grounds…is not fully known, but is presumed to be trans-oceanic.” During migration, birds are observed in Willapa Bay, the Willamette Valley, Humboldt Bay, and in San Francisco Bay (Springer and Lowe, 1998; 66 *FR* 15643). Birds from the Aleutian Islands arrive on the wintering grounds in California in mid-October from the Crescent City area to Modesto, or in precious years, points further south (see Springer and Lowe, 1998 and 66 *FR* 15643 for detailed locations of wintering and feeding areas in California). In midwinter, most of the birds are concentrated near Modesto, California. Areas used include the Crescent City. They feed primarily on grass, waste beans, and grain on agricultural lands (Springer and Lowe, 1998; 66 *FR* 15643). Staging occurs primarily near Crescent City, where the birds roost on offshore islands. The northward migration of birds that nest at Chagulak Island may differ slightly from that of the western Aleutian nesting birds. Birds that breed in the Semidi Islands apparently winter exclusively in coastal Oregon near Pacific City, foraging on dairy pastures, and roosting on Haystack Rock in the Oregon Islands National Wildlife Refuge on the ocean (66 *FR* 15643). A small number of individuals from the Aleutian Islands has been observed recently to nest with the Semidi Island geese (D. Pitkin, cited in 66 *FR* 15643).

Peak counts of Aleutian Canada geese on California wintering grounds (these are the geese that nest in the western and central Aleutians) has increased from 6,300 in 1989-1990 to 36,978 in 1999-2000. Comparable peak counts of Semidi Islands nesting birds counted on wintering grounds in Pacific City, Oregon was 115 in 1989-1990 and 129 in 1999-2000. In March 2001, the Fish and Wildlife Service (66 *FR* 15643:15645) summarized that “the Aleutian Canada goose population is now about 37,000 individuals” and that since 1990, “…the annual rate of growth of the population…has average about 20%.” The Fish and Wildlife Service report that the overall annual growth rate of the population since recovery activities began in the 1970’s has been about 14%.

III.B.4.c(3)(f) Use of Areas Within and Near the Proposed Cook Inlet Multiple-Sales Area

This species historically nested on islands just to the south of Kodiak Island. It does not, and there is no information indicating that it has ever, nested or overwinter within or near the proposed multiple-sales area. The nearest nesting currently is in the Semidi Islands. The nearest area where large numbers of birds overwinter appears to be northern California.

The proposed Cook Inlet lease sales area is not part of the normal migration range of this subspecies (Byrd, 2002, pers. commun.). Recently, there have two sightings (of one individual each) of Aleutian Canada geese in areas near the proposed lease sales area. One sighting was in the Kachemak Bay region, and one was in the area near Anchor Point (E. Bailey communication to V. Byrd, Byrd, 2002, pers. commun.). In the 1995 Biological Opinion on the Cook Inlet/Shelikof Strait Planning Area Oil and Gas Lease Sale 149, (Biological Opinion in USDOI, MMS, Alska OCS Region, 1995), the Fish and Wildlife Service concluded:

> The lease area is generally outside the current range of Aleutian Canada geese…migrating birds have recently been reported as close as the Kalsin Bay area on Kodiak Island. It is also likely that other areas of the Kodiak Archipelago are visited occasionally during migration. This subspecies is not known to rest on salt water during migration….

The proposed area for Cook Inlet Sale 149 included blocks in Shelikof Strait that are not included in the proposed area for either Sale 191 or Sale 199. Hence, any Proposed Actions would be further from the locations of the geese that they would have been under Sale 149. A map depicting migration of this species (USDOI, Fish and Wildlife Service website) indicates Aleutian Canada geese crossing the Gulf of Alaska from areas west of Kodiak Island.

III.B.4.c(3)(g) Life-History Characteristics

Geese generally first breed at 2-3 years of age, form lifelong pair bonds with mates, generally establish a nesting territory, produce four to five eggs per nest, and raise their young as a family unit (State of Alaska, Dept. of Fish and Game Wildlife Notebook Series). Aleutian Canada geese nest on treeless islands in areas of dense grasses, sedges, and ferns often on steep, grassy hillsides near the seacoast. Unlike many other Canada goose species, they do not appear to require proximity to estuarine or freshwater sources (Fish and Wildlife Service Biological Opinion in USDOI, MMS, Alaska OCS Region, 1995). Geese generally are unable to fly for about a month in midsummer during the molt. The Fish and Wildlife Service (website on natural history) reports that molting sites generally are located farther inland than nesting locations. During migration and winter, they feed primarily on grass, waste beans, and grain on agricultural lands (Springer and Lowe, 1998; 66 *FR* 15643).

III.B.4.c(3)(j) Causes of Previous Endangered Status and Factors Leading to Recovery

The introduction of the Arctic fox (*Alopex lagopus*) and, to a lesser extent, red fox (*Vulpes vulpes*), to more than 190 of the nesting islands of the Aleutian Canada goose and the resultant preying of the fox on goose eggs; goslings; and flightless, molting geese, caused the precipitous decline of this subspecies. The Fish and Wildlife Service (66 *FR* 15643) concluded that hunting and habitat alteration and loss on migration routes and wintering grounds contributed to the decline of this subspecies, with hunting probably being a limiting factor when populations were low.

The Fish and Wildlife Service (66 *FR* 15643) concluded that 4 activities led to the recovery of the Aleutian Canada goose. First and primary was the removal of introduced foxes from nesting islands. Also, captive-reared and wild, translocated geese were moved to fox-free islands; geese were protected from hunting and measures were taken to reduce impacts of disease; and lastly, the protection and management of migration and wintering habitat.

III.B.4.c(3)(k) Known Current Rates and Causes of Mortality and Other Identified Factors of Conservation Concern

Clearly, the greatest historical threat to the subspecies of goose was the introduction of foxes to its nesting islands. Between 1949 and 2001 (at the time of delisting), foxes had been removed from many (more than 33) islands, but they remain on many others. The Fish and Wildlife Service has identified the following factors that could still negatively impact the status of Aleutian Canada geese: development and modification of wintering habitat, continued presence of fox on some nesting islands, disease, predation by bald eagles (on some islands), and possible reduction of genetic variability due to previous severe population reduction and subdivision (Pierson, Pearce, and Talbot, 2000).

Many of the important wintering areas for Aleutian Canada geese are on private land. The major areas used by Semidi Island birds for wintering are on private lands (Fish and Wildlife Service, 1991). The Fish and Wildlife Service recently established the Nestucca Bay National Wildlife Refuge in Oregon to protect winter habitat. The Fish and Wildlife Service concludes that "…enough migration and wintering habitat is currently held in public ownership or conservation easements to ensure the continued viability of the subspecies at or near current numbers" (66 *FR* 15651). They concluded also that "The size of the current population and the management practices on currently used goose habitats also lead us to believe that potential threats such as development, variable market conditions, changing agricultural practices, and adverse climatic conditions do not currently threaten the continued survival of the Aleutian Canada goose now or in the foreseeable future" (66 *FR* 15643:15652).

Other, much more minor factors that could result in mortality include shooting, drowning, collisions and predation, and trapping accidents. Predation of eggs and/or goslings by ground squirrels, non-native rats, and glaucous-winged gulls (*Larus glaucescens*) may be limiting production in the Semidi Islands (Beyersdorf and Pfaff, 1995; 66 *FR* 15643).

Historically, Aleuts, market hunters and "sport" hunters harvested Aleutian Canada geese in the Pacific flyway (66 *FR* 15643). Sport hunting limited population growth, when the population size already was greatly reduced due to fox predation.

III.B.4.c(4) American Peregrine Falcon (*Falco peregrinus anatum*) – Delisted 1999

III.B.4.c(4)(a) General Description

Peregrine falcons are well known as one of the fastest birds of prey and as a species that suffered drastic declines and, in some cases, extirpation, in North America after World War II due to pesticide contamination (Hickey and Anderson, 1969; Cade et al., 1988; Wright and Bente, 2001). An approximately crow-sized bird, they weigh about 1,000 grams (36 ounces), with a wingspan of about 112 centimeters (44 inches) (64 *FR* 46542).

The American peregrine falcon is a medium-sized, migratory subspecies of peregrine falcon, one of three subspecies, in addition to the Peale's and Arctic peregrines, that occur in Alaska (Brown and Amadon, 1968). As discussed in the following under Distribution, this subspecies probably occurs in the Gulf of Alaska/Cook Inlet area only irregularly during migration or occasionally to overwinter (USDOI, Fish and Wildlife Service, 1982). Populations of both American and Arctic peregrines declined significantly, and both were previously listed as endangered under the ESA. Peale's peregrine falcon is the subspecies that is more common in areas near the proposed multiple-sales area. Peales's peregrine nests in coastal regions from the Aleutian Islands south through the Gulf of Alaska to southeast Alaska (Wright and Bente, 2001). Peale's peregrine is not, and has never been listed as endangered or protected in Alaska under similarity of appearance provisions of the ESA in Alaska. American peregrines are darker and larger and have more extensive black marking on their face than Arctic peregrines.

Peregrines feed almost entirely on other birds, such as songbirds, shorebirds, ducks, starlings, and pigeons, and occasionally on bats. They typically fly high above their prey and then dive, striking their prey in midair. As discussed below, their ecological role as a top predator led to their previous endangered status, as it exposed them to contaminants that bioaccumulated in their prey.

III.B.4.c(4)(b) Protective Legislation and Current Protective Status

The American peregrine falcon was included in the United States' list of endangered foreign species on June 2, 1970, under the Endangered Species Conservation Act of 1969. It was included on the native list of endangered species under this same act on October 13, 1970). On passage of the ESA in 1973, the American peregrine falcon subspecies (and the Arctic subspecies) were listed as endangered throughout their respective ranges. In 1984, the Fish and Wildlife Service published a final rule that included clarification of the status of American peregrines in some parts of their range and designated all free-flying peregrines in the 48 conterminous United States as endangered under the similarity of appearance provisions of the ESA under which similar-looking species or subspecies are afforded protection in order to avoid unintentional harm to listed species. Critical habitat was never designated for the American peregrine in Alaska.

As a component of a national program to restore peregrine populations, four recovery plans were completed in the 1970's, including three regional plans for the American peregrine: Alaska, Rocky Mountains/Southwest United States, and the Pacific Coast of the United States.

The American peregrine falcon was removed from the protection of the Endangered Species Act on August 25, 1999. Areas within California that were designated were removed as critical habitat upon publication of the final rule to remove the American peregrine from the Federal Government's list of endangered and threatened wildlife (64 *FR* 46542). The American peregrine was removed from the Alaska State Endangered Species List in 1993 and placed on the Alaska Department of Fish and Game's list of Species of Special Concern.

In 1999, the Fish and Wildlife Service published a Notice of Intent to develop two joint State/Federal Management plans to govern take of wild peregrines and to develop two Environmental Assessments as part of this process (64 *FR* 53686). One management plan was to address take of peregrine nestlings in the

United States, and the other to address take of immature peregrines that originate in Alaska, Canada, and Greenland but that migrate through the contiguous United States.

III.B.4.c(4)(c) Historic and Current Distribution and Abundance

Peregrines have an almost worldwide distribution (64 *FR* 46542), but subspecies tend to inhabit different regions. The Fish and Wildlife Service summarizes that the American peregrine occurs over much of North America, from subarctic boreal forests of Alaska and Canada to Mexico. It also nests over a large area from

> …central Alaska, central Yukon Territory, and northern Alberta and Saskatchewan, east to the Maritimes and south (excluding coastal areas north of the Columbia River in Washington and British Columbia) throughout western Canada and the United States to Baja California, Sonora, and the highlands of central Mexico (64 *FR* 46542).

In Alaska, specifically, the American peregrine falcon breeds in interior Alaska south of the Brooks Range; Peale's peregrine falcon breeds in coastal areas of southwest, Southcentral, and southeast Alaska; and the Arctic peregrine breeds north of the Brooks Range (White, 1968). Subarctic-nesting American peregrines tend to overwinter in South America (64 *FR* 46542). American and arctic peregrines are both highly migratory and winter from the southern United States south to Argentina (Ambrose and Riddle, 1988; Britten, 1998; S. Ambrose and T. Swem, cited in Ambrose et al., 2000).

Peregrines probably were never very abundant. The Fish and Wildlife Service reports that there were about 1,000 breeding pairs in the western United States and Mexico and about 500 breeding pairs in the eastern United States in the 1930's and 1940's. After World War II, peregrines declined precipitously in North America (Kiff, 1988).

Due to conservation efforts, including banning of the use of DDT in Canada in 1970 and in the United States in 1972, restrictions of the use of other organochlorine pesticides in the United States in 1974 and in Canada, captive breeding and relocation programs (for example, see Enderson et al., 1995), and translocation of wild hatchlings, peregrine falcons are now found nesting in nearly all states within their historic range (64 *FR* 46542). While populations of American peregrine falcons were locally depressed in Alaska and northwest Canada, enough individuals survived to permit populations to recover within the release of captive-bred falcons (64 *FR* 46542).

In the late 1970's, American peregrine falcon populations in Alaska were recovering (Ambrose et al., 1988b) and by 1980, population increase was documented in many other locations (Enderson et al., 1995). The Alaska Recovery Plan (USDOI, Fish and Wildlife Service, 1982) established recovery objectives that were based on four measures to assess the status of American peregrine falcons in Alaska. These measures were population size (measured as number of nesting pairs) in the upper Yukon and upper Tanana), reproductive performance (measured as average number of young produced per pair), pesticide residue level in eggs, and eggshell thickness. The Alaska Recovery Plan set a goal of less than 5 parts per million DDT and less than 10% eggshell thinning. Based on the aforementioned measurements, the Fish and Wildlife Service concluded that the goals underlying all objectives were met or exceeded: the number of breeding pairs and productivity in the specified and monitored areas exceeded recovery objectives, and neither DDE residues in eggs nor eggshell thinning had prevented population growth since the late 1970's (64 *FR* 46542).

The recovery plan developed by the Alaska Peregrine Falcon Recovery Team recognized the need to monitor population trends, identify nesting habitats and prey species and protect nesting habitat (Wright and Bente, 2001). Two representative areas established for regular surveying in the Alaska Peregrine Falcon Recovery Plan (USDOI, Fish and Wildlife Service 1982) for the American peregrine falcon. These areas were the Tanana and the upper Yukon Rivers (Wright and Bente, 1998). After delisting of the American and Arctic peregrine, periodic surveys are conducted in the same areas. Because surveys were also recommended for other areas within the range, the Middle and Lower Yukon River were surveyed annually from 1979-1991 and the coastline of Norton Sound from 1987-1991.

Data from index areas indicate that the numbers of American peregrine falcons nesting in Alaska have been increasing since 1968. On the Tanana River, 34 pairs and 3 singles were observed in 1995, up from a low of 0 in 1976 and fewer than 10 between 1970 and 1987 (see Table 5 in Wright and Bente, 2001). The productivity of young by American peregrines nesting on the Tanana River also has increased greatly over the past decade, from about 12 young being produced in 1986 to a high of 74 young being produced in 1994. Productivity increased since 1987, declining only slightly in 1995. Survey data available from 1996 were not comparable to data collected in other years. In July of 2000, Wright and Bente (2001) compared the numbers of American peregrines and the productivity of nests observed during surveys conducted along the middle and lower sections of the Yukon River, an area surveyed as complementary to the primary study areas established in the Alaska Peregrine Falcon Recovery Plan (U.SDOI, Fish and Wildlife Service, 1982). The number of sites occupied by American peregrines increased on the Middle Yukon River to 32 sites in 2000 from 16 sites in 1991. A much lower increase in the number of sites occupied was observed on the Lower Yukon, 62 sites in 2000 versus 59 sites in 1991. In addition to more nesting birds, there were more single birds, suggesting the population will continue to increase (Wright and Bente, 2001). However, average nest productivity was lower in 2000 in both regions than it had been in 1991. Peregrines probably occur in the Gulf of Alaska/Cook Inlet area only irregularly during migration (USDOI, Fish and Wildlife Service, 1982).

In the Final Rule to remove the American peregrine from the endangered species list, the Fish and Wildlife Service stated: "Populations in some portions of the range…such as Alaska, northwest Canada, and southwestern United States, reached densities several years ago that suggested recovery was approaching completion" (64 *FR* 46544) (for example, see discussion and data in Ambrose et al., 1988).

III.B.4.c(4)(d) Causes of Previous Endangered Status

Peregrines are top predators that are vulnerable to the effects of the bioaccumulation of environmental contaminants. As reviewed in Risebrough and Peakall, 1988), research indicated the decline of peregrine falcons was due to contamination by organochlorine pesticides, especially DDT and its metabolites (such as DDE), which accumulated in the fatty tissues of species ingesting contaminated food (Fyfe et al., 1988). Exposure to organochlorines can affect peregrine falcons through reproduction and via direct mortality. The effect on mortality is not as well studied. However, it is clear that organochlorines can adversely affect peregrine reproduction by causing the thinning of eggshells, premature breakage of eggs, addling of eggs, hatching failure, and abnormal reproductive behavior of the adults (Risebrough and Peakall, 1988). Exposure to DDE can prevent normal calcium deposition; populations of peregrines with eggshells that were on average 17% thinner or more than normal has high enough rates of reproductive failure to cause population decline (Peakall and Kiff, 1988). Thus, the previous endangered status of the American peregrine falcon resulted from widespread eggshell thinning and reproductive failure caused by exposure to persistent organochlorine due to the bioaccumulation of chlorinated pesticides (Ambrose et al., 2000).

Successful reproduction in some areas virtually ceased (Hickey and Anderson, 1969). The degree of exposure varied among areas (see 64 *FR* 46542) with resultant differences in the degree of impact on the populations. In most areas of the Pacific coast of Alaska, breeding populations of peregrines remained fairly stable (64 *FR* 46543). In contrast, impacts in many other regions of North America were severe. In agricultural and forested areas east of the Mississippi River in the United States and in eastern Canada south of the boreal forest, in Great Plains states east of the Rocky Mountains, and south of the boreal forest in the U.S. and Canada, peregrines were extirpated in the DDT-era (64 *FR* 46542; Enderson et al., 1995; Berger, Sindelar, and Gamble, 1969). Peregrines also were significantly reduced west of the 100th meridian (Enderson, 1969), disappeared as a breeding species in southern California, and declined greatly in other parts of the western United States and in many parts of southern Canada and the Northwest Territories (Kiff, 1988).

III.B.4.c(4)(e) Life-History Characteristics Related to Conservation Status and Evaluation of Potential Effects of the Proposed Action

Peregrines generally reach sexual maturity at 2 years of age. They tend to nest in a scrape or depression on a cliff ledge, or less frequently in a tree cavity, or an old stick nest. In the late 1990's, the Fish and Wildlife Service reported (64 *FR* 46550) that 87% of the pairs in the Midwest nested on manmade structures such as skyscrapers or bridges. Peregrines usually are present in Alaska from about mid-April to mid-September. Egg laying begins in early May in Interior Alaska and early June on the North Slope; the young fledge in late July and mid-August, respectively. They lay an average of four eggs in a clutch in spring. They have been known to abandon nests after severe or continuous harassment (USDOI, Fish and Wildlife Service, 2002a). Limited data regarding migration routes suggest that peregrines from the North Slope and eastern Interior Alaska generally follow the central flyway, while those from the western interior follow the Pacific flyway.

III.B.5. Marine and Coastal Birds

The marine and coastal bird community of Cook Inlet and the Gulf of Alaska, where proposed Sales 191 and 199 are located, is both diverse and complex. Three major groups are represented: seabirds, which make their living primarily on the open ocean; waterfowl (ducks and geese), which inhabit a variety of freshwater and nearshore marine habitats; and shorebirds, which feed mainly on marine and freshwater shorelines. More than 100 species may occur in this area, including 39 seabird species; 35 loon, grebe, and waterfowl species; and 28 shorebird species. Many of these species are afforded protection under the Migratory Bird Treaty Act of 1918. The Migratory Bird Treaty Act, which is enforced by the USDOI, Fish and Wildlife Service, prohibits the take; possession; import; export; transport; selling; purchase; barter; or offering for sale, purchase, or barter of, any migratory bird and eggs, parts, and nests, except as authorized under a valid permit (50 CFR 21.11). Threatened and endangered birds, which are protected under the Endangered Species Act, are discussed in Section III.B.4. General descriptions of the distribution, abundance, and biology of marine and coastal birds that occur in the Cook Inlet and the Gulf of Alaska are found in the Cook Inlet Planning Area Oil and Gas Lease Sale 149 Final EIS (USDOI, MMS, Alaska OCS Region, 1995), the Gulf of Alaska/Cook Inlet Sale 88 Final EIS (USDOI, MMS, Alaska OCS Region, 1984), and the Lower Cook Inlet-Shelikof Strait Sale 60 Final EIS (USDOI, BLM, Alaska OCS Office, 1981). More detailed information can be found in Gabrielson and Lincoln (1959), Isleib and Kessel (1973), Erikson (1976), Kessel and Gibson (1978), Sowls et al. (1982), Agler et al. (1995), Gill and Tibbitts (1999), and Piatt (2002). These documents are summarized and incorporated by reference and updated by additional references as cited below.

Breeding seabirds are an important component of the Cook Inlet bird population. In fact, more seabirds breed in the Inlet than throughout the entire northeastern Gulf of Alaska (Sowls, Hatch, and Lensink, 1978; Piatt, 2002). The most abundant breeding seabirds are fork-tailed storm petrels, tufted puffins, black-legged kittiwakes, common murres, horned puffins, and glaucous-winged gulls (Kettle, 2003, pers. commun.; Bailey, 1976; Simons and Pierce, 1978; Roseneau, Kettle, and Byrd, 2000; Piatt, 2002).

Within the lower Cook Inlet area, the largest concentration of seabirds occurs in the Barren Islands. Recent counts and estimates of seabirds on the Barren Islands (Kettle, 2003, pers. commun.; Roseneau, Kettle, and Byrd, 2000), supplemented by earlier census data (Bailey, 1976; Simons and Pierce, 1978), indicate a total of nearly 420,000 breeding seabirds for these colonies. However, these counts do not include birds at sea. In addition, this figure includes an estimate of fork-tailed storm-petrel population size for only one island—100,000 at East Amatuli (Simons and Pierce, 1978), and this species is abundant on at least two other islands in the group (Kettle and Roseneau, pers. commun.). Therefore, it appears that the Barren Islands' actual breeding population is at least 500,000 birds and possibly substantially larger.

Large seabird colonies also occur at the Chisik-Duck Islands on the west side of the Inlet (about 30,000 birds) and on Gull Island in Kachemak Bay (about 20,000 birds) (Piatt, 2000). Other colony concentrations occur south of the lease sale area in Puale and Dry bays (161,000 birds). Smaller colonies are present in Kamishak Bay and on northwestern Afognak and western Shuyak islands (Sowls, Hatch, and Lensink, 1978; Bailey and Faust, 1982).

The most abundant waterfowl species in the lower Cook Inlet include scoters, long-tailed ducks, eiders, and goldeneyes (Agler et al., 1995). Among the shorebirds, western sandpipers, rock sandpipers, and dunlins predominate in the lower Inlet at various seasons (Gill and Tibbitts, 1999). Kachemak Bay was identified recently as a Western Hemisphere Shorebird Reserve because of its importance to shorebirds of the Pacific Flyway. Common or abundant marine and coastal birds that are resident or migrant species in the lower Cook Inlet area are listed in Table III.B-8.

III.B.5.a. Seasonal Distribution

III.B.5.a(1) Spring (April-May)

The highest coastal bird density occurs in the Cook Inlet area in spring (Table III.B-9), when large numbers of waterfowl and shorebirds migrate through this area, swelling the substantial numbers of overwintering waterfowl and gulls present (Arneson, 1980; Gill and Tibbitts, 1999). Arneson (1980) recorded densities of more than 300 birds per square kilometer in Tuxedni Bay and more than 400 per square kilometer in southern Kamishak Bay; a majority of the latter were shorebirds and sea ducks. Other areas with substantial bird concentrations include inner Kachemak Bay (mainly sea ducks and diving ducks, shorebirds, and gulls); Redoubt Bay (mainly shorebirds, geese, and ducks); and the Iniskin-Iliamna Bay (mainly shorebirds and diving ducks) (Table III B-9). Gill and Tibbitts (1999) found spring to be the season of greatest shorebird abundance and diversity in Cook Inlet. Numbers peaked quickly, with migrants arriving in late April and peaking at about 175,000 birds in mid-May before declining. Although 28 species were identified, western sandpipers overwhelmingly predominated, accounting for 89% of the total.

The greatest variety and numbers of birds occur in exposed inshore waters and the various habitats associated with bays and lagoons, including open water, tidal mudflats, deltas, floodplains, and salt marshes (USDOI, MMS, Alaska OCS Region, 1984). Loons, grebes, cormorants, sea ducks, and alcids are most frequently found on bays and exposed inshore waters. Geese and dabbling ducks primarily use river floodplains and marshes, while diving ducks spend most of their time on bay waters. Shorebirds are found primarily on mudflats and gravel areas. Gulls use a variety of habitats, especially those associated with lagoons.

III.B.5.a(2) Summer (June-August)

Bird density in Cook Inlet coastal habitats declines between spring and summer (Table III B-9). Departure of shorebirds and waterfowl accounts for most of this decline. Densities of cormorants, gulls, and alcids increase in summer (Arneson, 1980). Agler et al. (1995) found the most common seabirds during June to be alcids (particularly murres, puffins, and murrelets); tubenoses (including shearwaters, fulmars, and storm-petrels) were the second most abundant. They counted an estimated 798,000 marine birds in lower Cook Inlet, with densities decreasing with distance from shore; 152.9 birds per square kilometer were counted within 200 meters of shore, 71.6 birds per square kilometers between 200 meters and 3 nautical miles, and 50.7 birds per square kilometer beyond 3 nautical miles (Agler et al., 1995). The highest summer density in western Cook Inlet occurs in Tuxedni Bay (Table III.B-9). As in spring, the Chisik Island kittiwake colony accounts for the majority of the nesting seabirds on the western side of the inlet. However, both black-legged kittiwake and common murre colonies on Chisik and Duck Islands have declined over the past 30 years—kittiwakes have declined from about 25,000 to 14,000-20,000 adult birds since 1970 (Zador et al., 1997; Shultz, 2002), and common murres from about 25,000-2,500 adult birds (van Pelt and Shultz, 2002).

Bird densities of more than 200 per square kilometer have been estimated for Kachemak Bay and southwest Kamishak Bay, with gulls and sea ducks being the major species groups (Arneson, 1980). Sea ducks are abundant in the Iniskin-Iliamna Bay and outer Kachemak Bay area, and high densities of gulls occur near Kenai and in the Chugach Islands. During June, marine birds are distributed throughout Cook Inlet, with concentrations of more pelagic species such as shearwaters, murres, puffins, and murrelets occurring in the eastern half near the entrance to Kachemak Bay and the southeastern corner of the Inlet (Agler et al., 1995). Concentrations of marbled murrelets generally occur within bays and fjords on the eastern side of Kodiak and Afognak islands; they are also found along the coasts of lower Kenai Peninsula, Kachemak Bay, Shuyak Island, and Hallo Bay on the south side of the Alaska Peninsula (Piatt and Naslund, 1995). Recent pelagic surveys conducted during June-August observed densities of more than 100 birds per square kilometer in waters at the mouth of the Inlet near the Barren Islands, with highest densities (325 birds per square kilometer) recorded off Shuyak Island (Table III.B-9) (Piatt, 2002; Speckman, 2002). Almost half of these birds were shearwaters; puffins, gulls, murres, murrelets, phalaropes, storm-petrels, fulmars, and guillemots were also abundant (Speckman, 2002).

III.B.5.a(3) Fall (September-October)

Average bird densities in fall are only one-third to one-half of those observed in spring and summer (Table III.B-9). Departure of gulls and sea ducks accounts for most of the decline. By October, most alcids have departed for pelagic waters. Only dabbling duck and goose densities increase in fall, as migrating birds move into the area. Numbers of shorebirds remain low (Gill and Tibbitts, 1999). Fall densities exceeded 100 birds per square kilometer in four areas of Cook Inlet: inner Kachemak Bay, southwestern Kamishak Bay, Tuxedni Bay, and northwestern Kachemak Bay (Arneson, 1980). Dabbling ducks, sea ducks, and gulls accounted for 85% of total birds observed. Habitat use in fall is similar to that in spring and summer; habitats associated with bays and lagoons are used most heavily (Arneson, 1980).

III.B.5.a(4) Winter (November-March)

Overall, winter bird densities in lower Cook Inlet are roughly half that observed in summer (Table III.B-9) (Agler et al., 1995). Most of this decrease occurs offshore, reflecting seasonal changes in species composition as shearwaters, gulls, and murres leave the area (Agler et al., 1995). In contrast, waterfowl densities increase markedly; sea ducks (primarily scoters, long-tailed ducks, eiders, and goldeneyes) are the most abundant group remaining in winter (Agler et al., 1995). Winter bird densities are higher in eastern Cook Inlet than on the western side. Inner Kachemak Bay has the highest density (Table III.B-9) with ducks making up most of this total. Birds reported by Agler et al. (1995) in Kachemak Bay were primarily sea ducks, of which 52% were scoters and alcids, 63% were murres, and 29% were murrelets. On the western side of the inlet, the highest density has been recorded in Tuxedni Bay, while no other area on the western side of Cook Inlet exceeds 27 birds per square kilometer in winter (Arneson, 1980). Coastal habitats used most heavily in winter are bays, exposed inshore waters, mudflats, and lagoons.

A single species of shorebird, the rock sandpiper, predominates in Cook Inlet during the winter when as many as 20,000 may be present (Gill and Tibbitts, 1999). This may represent the entire Bering Sea-breeding population of this species. Most of these birds remain in upper Cook Inlet, foraging on the Susitna Flats and in Trading Bay. However, rock sandpipers have been sighted regularly in Kachemak Bay in the winter, and they apparently may move southward into Redoubt and Tuxedni bays in the low thousands when harsh weather or icy conditions preclude foraging farther north (Gill and Tibbitts, 1999).

The Kodiak Island-Shelikof Strait area is recognized as an important wintering ground for several waterfowl and seabird species (Forsell and Gould, 1981; Zwiefelhofer and Forsell, 1989; Piatt and Naslund, 1995; Larned and Zwiefelhofer, 2001). Forsell and Gould (1981) estimated that about 40,000 cormorants, 65,000 long-tailed ducks, 13,000 king eiders, 35,000 white-winged scoters, 30,000 black scoters, 200,000 common murres, 17,800 murrelets, and 50,000 crested auklets wintered in the Kodiak Island-Shelikof Strait region. Estimates for other species groups included 11,500 dabbling ducks, 35,000 sea ducks, 10,000 gulls, and 8,500 alcids (approximately 516,000 total). About 77,000 fulmars, 65,000 black-legged kittiwakes, 45,000 glaucous-winged gulls, and 800,000 common murres were estimated to winter over the Kodiak shelf. The most abundant birds wintering in Uyak and Uganik Bays on the western side of Kodiak Island are common murres, long-tailed ducks, black and white-winged scoters, marbled murrelets, pelagic and red-faced cormorants, crested auklets, mew gulls, and harlequin ducks (Zwiefelhofer and Forsell, 1989; Piatt and Ford, 1994; Piatt and Naslund, 1995; Larned and Zwiefelhofer, 2001). Concentrations of marbled murrelets occur in sheltered waters of bays, fjords, islands, and straits off Kodiak and Afognak Islands adjacent to coastal coniferous forests (Piatt and Naslund, 1995). Annual winter surveys of Uyak and Uganik Bays on the western shore of Kodiak Island since 1980 indicate that overwintering populations of marbled murrelets, loons, cormorants, mew gulls, and common murres are stable, while pigeon guillemot numbers have declined by 50% in the past 15 years (Zwiefelhofer, 1995).

Arneson (1980) found an average winter density of 39 birds per square kilometer in the Kodiak area. Forsell and Gould (1981) found 40.2 birds per square kilometer in Shelikof Strait (November-December) and 64.0 to 68.6 birds per square kilometer in the northwestern Kodiak Island area (equivalent to about 75,000 birds in three northwestern bays). In late winter (February-March), these densities increased to 114.5 birds per square kilometer on northwestern Kodiak Island. The most abundant groups (November-December) are cormorants, scoters, gulls, murres, murrelets, and puffins. Large concentrations of crested auklets have been reported in the Kupreanof Strait-Whale Pass area of Kodiak during the winter (Dick and Donaldson, 1978).

III.B.5.b. Food Sources-Trophic Relationships

At least six major prey species have been identified for seabirds during the spring and summer seasons for the western Gulf of Alaska/Cook Inlet area. They include capelin, pollock, sand lance, herring, euphausiid crustaceans, and squid (Baird and Moe, 1978; Sanger, Hironaka, and Fukuyama, 1978; Hatch, 1984; Baird, 1991; Piatt, 2002). The distribution and abundance of forage fish stocks reflect the oceanographic conditions in the lower Cook Inlet (see Section III.A.3.a) (Piatt, 2002). Piatt et al. (Piatt, 2002) found abundances of forage fish (and seabirds) to be one-to-two orders of magnitude higher in the colder, more productive waters of the east side; juvenile pollock and capelin predominated in the southeastern part of the Inlet, especially offshore, while sand lance and herring were the most abundant species in coastal waters off the Kenai Peninsula and in Kachemak Bay. Although forage fish abundance was much lower on the west side of the Inlet, several species (for example, sandfish, eulachon, and smelt) were largely restricted to this area.

Many of the common species, such as murres and puffins, are probably opportunistic in their foraging habits and may concentrate on whatever prey species of appropriate size are most abundant in the area. Piatt and coworkers (Piatt, 2002) found that the summer diets of common murres and black-legged kittiwakes, in particular, reflected the food supplies around their colonies and were dominated by four species: sand lance, herring, pollock and capelin. Several species, including horned puffins, marbled murrelets, and pigeon guillemots, fed largely on sandlance, generally in or near Kachemak Bay. More oceanic species (shearwaters, fulmars, storm-petrels, and phalaropes) foraged mostly in oceanic waters off the Barren Islands or in frontal waters in the lower Inlet, where they presumably fed on pollock and capelin.

Available information on the winter food habitats of sea ducks and alcids in Kachemak Bay indicate that sea ducks and alcids use several food items (Sanger, Jones, and Wiswar, 1979; Sanger and Jones, 1984; Sanger, 1987). Sea ducks feed primarily on benthic invertebrates, with clams and mussels important for oldsquaw and scoters, respectively (Sanger and Jones, 1984). Common murres use a variety of crustaceans, fishes, and polychaetes (Krasnow, Sanger, and Wiswar, 1979; Sangerm Jones, and Wiswar, 1979). The most important winter prey of marbled murrelets in Kachemak Bay is capelin (Sanger, 1987).

III.B.5.c. Migration

Seasonal shifts in avian populations in proposed sales area are largely a result of bird migration. Numbering in the millions, pelagic birds (shearwaters, petrels, and fulmars), gulls, waterfowl, and shorebirds are the primary groups that migrate through the area. The spring migration begins in late March and peaks from late April to early May (Erikson, 1976; Gill, Handel, and Petersen, 1978; Agler et al., 1995; Gill and Tibbitts, 1999; Piatt, 2002).

Large migratory breeding populations inhabit the Barren Islands and other seabird colonies. Millions of subadult seabirds spend the summer season in the western Gulf of Alaska-Cook Inlet area. Several million waterfowl and shorebirds move through the area in the spring. Important staging areas are located at Kachemak Bay, Douglas River mudflats, Kenai River mudflats, Tuxedni Bay, the Drift River, Chinitna Bay, Iliamna Bay, Ursus Cove, and other areas in lower Cook Inlet (Erikson, 1976). Use of bays and inlets in Shelikof Strait by migratory birds, especially along the Alaska Peninsula, is little known. The Katmai Bay area on the west side of Shelikof Strait is an important area for several species of sea ducks and shorebirds, including white-winged scoters, greater scaups, Barrow's goldeneyes, harlequin ducks, black turnstones, and greater yellowlegs (Cahalane, 1944).

Fall migration movements in Cook Inlet begin in July and end in November. By August, waterfowl begin to move south through the area, and wintering sea ducks begin to arrive. By early October, most breeding migrants and nonbreeding summer-season migrants have left. Shorebird numbers in the lower Cook Inlet remain low through the summer and early fall; rock sandpipers begin moving into the area in late October, reach a maximum in early November, and remain high until the end of March (Gill and Tibbitts, 1999).

III.B.5.d. Coastal Birds of Prey

The two major coastal birds of prey in the sale area are the bald eagle and the peregrine falcon. The bald eagle is a breeding, year-round resident along the coasts of lower Cook Inlet and Shelikof Strait. This species is very common along the coast of Kodiak, Afognak, and Shuyak Islands; the Alaska Peninsula; and the southern Kenai Peninsula (USDOI, MMS, Alaska OCS Region, 1995). During the 1980’s, nearly 2,000 eagle nests were counted along the coasts with over 1,400 nests on Kodiak, 298 nests on southern Kenai Peninsula, 277 nests on the south side of the Alaska Peninsula, and 90 nests on the coast of Katmai National Park (Schempf, 1992). A more recent estimate of the total population for the Kenai Peninsula, Kodiak, and the southern side of the Alaska Peninsula area is about 4,000 eagles (Schempf and Bowman, 1991). Although bald eagles have not been surveyed in the Cook Inlet region in recent years, populations in southeastern Alaska as a whole have been stable or increasing (Schempf, 2003, pers. commun.). Bald eagles feed primarily on fish or act as scavengers.

In southern Alaska, Peale’s peregrine falcons occur along the coast in the Gulf of Alaska south to British Columbia (Hughes and Sanger, 1999). This subspecies is not listed as threatened or endangered. Some nesting is known to occur on the Barren Islands (Bailey, 1976). In 1990, Hughes and Sanger (1999) conducted a field survey of peregrine falcons in the northern Gulf of Alaska, from the southeastern tip of the Kenai Peninsula northeast through Prince William Sound. They recorded highest nest-site densities along the southern coast of the Kenai Peninsula and concluded that the peregrine falcon population in their study area was healthy in 1990; extrapolation from their population estimate for the entire study area indicates a population of more than 60 adults for the southern Kenai Peninsula. Peregrines frequent the heads of bays, where they prey on seabirds, waterfowl, and shorebirds (Hughes and Sanger, 1999).

III.B.6. Nonendangered Marine Mammals

Seven species of nonendangered marine mammals are resident or commonly occur seasonally in the Cook Inlet Planning Area: Pacific harbor seals; northern fur seas; Southcentral Alaska sea otters; harbor porpoises; Dall porpoises; and killer, gray, and minke whales.

III.B.6.a. Pinnipeds

III.B.6.a(1) Pacific Harbor Seals

Harbor seals are distributed in coastal waters along virtually the entire lower Cook Inlet coastline and are generally nonmigratory. Local movements are associated with food and breeding (Bigg, 1981). Harbor seals occupy a wide variety of habitats in fresh- and saltwater and along protected and exposed coastlines. They prefer to haul out on gently sloping or tidally exposed habitats including reefs, offshore rocks and islets, mud and sand bars, sand and gravel beaches, and floating and shorefast ice (Calambokidis et al., 1987; Bigg, 1981; Pitcher and Calkins, 1977). Harbor seals tend to have a strong fidelity to traditional haulout sites although a radio-tagged individual was recorded over 190 kilometers from its usual haulout site, and one seal crossed 74 kilometers of open ocean (Pitcher and McAlister, 1981). Typically, one or two sites are used by an individual in a given area. Important harbor seal haulout areas occur within Kamishak and Kachemak Bays and along the coast of the Kodiak Archipelago and the Alaska Peninsula (see Map 16). Pupping appears to take place at most haulouts, and several of these areas contain large numbers of animals.

Current population estimates for the area are as follows: Gulf of Alaska, 19,450 seals; Cook Inlet, 2,244; Kodiak, 4,437; and the south side of the Alaska Peninsula, 3,200 (Ferrero et al., 2000). The Kodiak population declined steadily from about the mid-1970’s to the 1990’s, with the Tugidak Island population, once the world’s largest concentration, declining by 85% between 1976 and 1988, from 6,919 seals to 1,014 (Pitcher, 1990). More recently, this population has increased from 769 seals in 1992 to 1,420 in 1996 (Small, 2001). Between 1994 and 1995, the mean and maximum number of seals ashore increased more than 50% (Jemison and Kelly, 2001). Despite some signs of growth in certain areas, the Gulf of Alaska stock remains low compared to its size in the 1970's and 1980's (Ferrero et al., 2000).

The reason for the decline is unknown, but it mirrors the decline of Steller sea lions in the gulf; there was no evidence that disease was a factor as it was for seal declines in New England and in northern Europe (Geraci et al., 1982; Markussen, 1992). The harbor seal decline in the Cook Inlet and Western Gulf of Alaska area may be related to the crash of the pandalid shrimp and capelin populations in the same area and over the same time period (Hansen, 1997; Anderson and Piatt, 1999). Predation by killer whales or sharks, or both, also could be a contributing factor. Shark predation on harbor seals has been recorded (Lucas and Stobo, 2000; Stewart and Yochem, 1985). Losses due to interaction with commercial fishing activities and subsistence harvests are estimated to be about 800 seals per year in the gulf (Ferrero et al., 2000).

Harbor seals are opportunistic feeders whose diet varies with season and location. In the Gulf of Alaska, Pitcher and Calkins (1979) found that fish—chiefly pollock and capelin—comprised 74.3% of total prey volume; cephalopods, 21.7%; and decapod crustaceans, 4.0%. Recent scat analysis from Kodiak seals show Irish lords (43%) and sand lances (25%) were predominate prey items (Jemison, 2001).

III.B.6.a(2) Northern Fur Seals

Northern fur seals range throughout the North Pacific between about 32º and 60º N. latitude. The population that breeds in Alaska, primarily on the Pribilof Islands in the Bering Sea, ranges from the Bering Sea and Aleutian Islands eastward through the Gulf of Alaska and southward to California. This population is currently estimated at a minimum of 941,756 seals (Angliss and Lodge, 2002). Pup production and the total seal population on the Pribilof Islands declined after the harvest of female seals from 1956-1968, increased to 1.25 million in 1974, but then declined again between 1976 and 1984. The population was estimated at 877,000 in 1983 (Briggs and Fowler, 1984, as cited by Loughlin, 1993). Recent pup counts between 1996 and 2000 have declined; the 2000 count was below 200,000 animals for the first time in over a decade (Angliss and Lodge, 2002). The reasons for the more recent population decline (1976-1984) are unknown, but some potential causes include:

- losses of young seals to entanglement in discarded nets and other fishing gear (Fowler, 1982; Fowler et al.,1992);
- possible predation by sharks on the fur seals' winter range (Hansen, 1987);
- reduction in the availability of food for young fur seals, potentially related to the buildup of commercial fishing in the Gulf of Alaska (Trites, 1992); and
- changes in environmental factors, such as sea-surface temperature on the winter range (York, 1985).

Northern fur seals are highly migratory and, with few exceptions, are found in nearly all months of the year throughout their range. Although they lead a pelagic existence when they are not breeding, northern fur seals temporarily haulout on land at nonbreeding sites in Alaska, British Columbia, and the continental United States (Loughlin, 1993). Their distribution in the Gulf of Alaska and throughout their winter range tends to be along the shelf break (200- to 2,000-meter isobaths) and offshore of the shelf break to beyond 100 kilometers (Bonnell, Bowlby, and Green, 1992; Fiscus, 1982) (see Map 16).

Most northern fur seals are dispersed over the OCS and slope from 16-160 kilometers offshore, the greatest numbers occurring between 48 and 113 kilometers (Baker, Wilke, and Baltzo, 1970). Most adult males overwinter in Alaskan waters, while most females and immature males winter in waters off British Columbia, Washington, Oregon, and California (Kajimura et al., 1980). Fur seals can be found year-round in the gulf, although they are most abundant during the spring (April-May) (Kajimura et al., 1980).

The northward migration of individuals wintering in southern parts of the range begins in March and, from April to mid-June, large numbers are found in Gulf of Alaska coastal waters (Consiglieri et al., 1982). In March, seals are still common in Sitka Sound (10.7 seals per survey hour), and numbers are increasing throughout Southeast Alaska. By April, the seal migration front reaches the vicinity of Albatross Bank off Kodiak Island; in this area, 11.2 seals have been observed per hour of survey time (Kajimura et al., 1980).

Fur seal numbers are highest in the Gulf of Alaska in May; surveys have recorded 9.8 seals per hour in offshore areas (Kajimura et al., 1980). In spring, densities over the OCS range from 0.5-1.6 seals per square kilometer; densities were highest over the shelf break (3.1 seals per square kilometer) and lowest in inshore waters (0.01-0.05 per square kilometer). The greatest concentrations during this period were observed from Kayak Island to southern Kodiak Island, especially off Portlock and Albatross Banks. During summer, the majority of those fur seals remaining in the Gulf of Alaska are primarily younger, nonbreeding individuals found near the shelf break and in shallower waters east of Kodiak Island. A number of fur seals (0.16-1.4 seals per square kilometer) remained in the northeastern part of the gulf. Survey sightings of at least nine seals per hour have been made in June near Montague and Middleton Islands and south of the Kenai Peninsula (150º-151º W. longitude). Densities in the gulf are low during the remainder of the summer and fall. Southward migration from the Pribilof Islands begins in October; by December, seals appear off Southeast Alaska.

Fur seals tend to congregate in areas over the OCS and slope, where nutrient upwelling results in an abundance of various schooling fishes such as capelin, sand lance, pollock, and herring and invertebrates such as squid, on which the seals feed (Perez and Bigg, 1986; Lowry, Frost, and Loughlin, 1989).

III.B.6.a(3) Other Pinniped Species

On occasion, Pacific walruses are sighted in the Gulf of Alaska, particularly in the Cook Inlet area. These rather unusual sightings generally occur during the winter or spring during years when the Bering Sea pack ice extends into the southern Bering Sea and near the Aleutian Islands. Stray walruses apparently move through the passes into the Gulf of Alaska/Shelikof Strait and into Cook Inlet. Adult male northern elephant seals seasonally migrate in the spring (late March) and again after the molting season (during August to December) from their breeding locations along the California coast into Alaskan waters, presumably to feed on squid and other food sources; and they return to their breeding sites to molt during July (Stewart and Delong, 1995; Delong, Stewart, and Hill, 1993; Stewart and Delong, 1990; Campbell, 1987). Individual bull elephant seals have been recorded as far west into Alaskan waters as the western Aleutians (LeBoeuf et al., 2000). Northern elephant seals have not been recorded in Cook Inlet.

III.B.6.b. Southcentral Alaska Sea Otters

Sea otters on the eastern side of Cook Inlet, Kachemak Bay, and the southern Kenai Peninsula are near to the proposed Cook Inlet Program Area. Sea otters in these regions are considered part of the Southcentral Alaska stock of sea otters. The overall trend of this stock is believed to be upward although specific regions within the range vary (USDOI, Fish and Wildlife Service, 2002b). This population is not listed or being considered for listing under the Endangered Species Act. Biological data relevant to this stock are available through summaries provided for comparison in the section on the southwest Alaska sea otter stock section. Below, we briefly provide population abundance information.

Many different kinds of surveys have been used to estimate abundance in this stock. Thus, abundance estimates or counts from different areas and different years are not always comparable.

The total estimate for the Southcentral Alaska sea otter stock is 21,749 sea otters. A minimum population estimate of 19,508 has been derived and a potential biological removal of 1,951 animals calculated (USDOI, Fish and Wildlife Service, 2002b).

Based on helicopter surveys of the Kenai Peninsula in the fall of 1989 following the *Exxon Valdez* oil spill, DeGange et al. (1995:4) estimated 2,146 sea otters resided along the Kenai Peninsula. Spring (in advance of the advancing oil from the spill) and autumn (post-oil) total adjusted population estimates for this region were not significantly different (DeGange et al., 1995). The most recent estimate for Prince William Sound is 13,234 from 1999 based on aerial surveys employing the methodology of Bodkin and Udevitz (1999). Agler et al. (1995) conducted a boat survey of lower Cook Inlet including Kachemak Bay in 1993 (this survey probably included sea otters from both the southcentral and southwest stocks). No correction for unseen animals was applied. A ratio estimator was employed to derive an estimate of 5,194 (coefficient of variation = 0.267). Doroff and Gorbics (1998) counted 271 sea otters along the coast between Cape Hinchinbrook and Cape Yakataga.

This stock was greatly impacted by the *Exxon Valdez* oil spill, especially in the western part of Prince William Sound. The Fish and Wildlife Service (2002b) reported that abundance of sea otters in some areas remains below prespill estimates and that sea otters might not yet have recovered from the *Exxon Valdez* oil spill (Stephensen et al., 2001). More detail on sea otters in Cook Inlet and on impacts to this stock from the *Exxon Valdez* oil spill is presented in the endangered species effects section and in the cumulative effects section.

III.B.6.c. Nonendangered Cetaceans

III.B.6.c(1) Harbor Porpoises

The current estimate of abundance for the Gulf of Alaska is 21,451 harbor porpoises, with a minimum estimate of 16,630 (Ferrero et al., 2000). The estimated abundance for the Kodiak Island area and the southern side of the Alaska Peninsula area was about 1,270 (ranging from about 900-1,760) animals in 1972 (Dahlheim et al., 1992). Densities were reported as 0.72 porpoises per square kilometer in Cook Inlet, 2.62 porpoises per square kilometer in the Kodiak area, and 2.23 porpoises per square kilometer along the south side of the Alaska Peninsula (Dahlheim et al., 2000). In spring and summer, harbor porpoise sightings are numerous in the Kodiak Island area and Kachemak Bay. Harbor porpoises have been observed in Cook Inlet and Shelikof Strait during winter months (Hansen and Hubbard, 1999). Harbor porpoises usually occur singly or in pairs.

The migratory movements of harbor porpoises are not well defined, but they are reported to move north in late May and south in early October on the Atlantic coast (Neave and Wright, 1969, as cited by Consiglieri et al., 1982). In addition, Gaskin et al. (1974, as cited by Consiglieri et al., 1982) predicted movement inshore in summer and offshore in winter; the decline in numbers of porpoises in Prince William Sound reported by Hall (1979) also suggests winter dispersion. Harbor porpoises generally are observed in harbors, bays, and river mouths. They also are seen concentrated in and along turbid river-water plumes, such as the Copper River and Icy Bay areas. Mating probably occurs from June or July to October, with peak calving in May and June (Tomilin, 1957, as cited by Consiglieri et al., 1982).

Harbor porpoises consume a wide variety of fish and cephalopods, apparently preferring nonspiny, schooling fish such as herring, mackerel, and pollock (Leatherwood and Reeves, 1987). An important source of local mortality of harbor porpoises is incidental catches in setnet and driftnet fisheries throughout the western coast of North America (National Marine Fisheries Service, 1980, as cited by Consiglieri et al., 1982); more than 50 harbor porpoises were predicted to be lost in the Prince William Sound/Copper River fisheries in 1978 (Matkin and Fay, 1979, as cited by Consiglieri et al., 1982).

III.B.6.b(3) Dall's Porpoises

Dall’s porpoises are present year-round throughout their entire range in the northeast Pacific—from Baja California to Alaska, including the Gulf of Alaska/Cook Inlet area (Morejohn, 1979). During most of the year, they inhabit waters deeper than 100 fathoms whereas in winter, they occur in deeper water or nearshore at about 50 fathoms (Morejohn, 1979). Their distribution is not as highly correlated with water depth in fall and winter, when they are more evenly dispersed over the entire gulf. Concentrations of Dall’s porpoises have been reported in Shelikof Strait and around Kodiak and Afognak Islands. The current Alaska population estimate is 83,400 animals, with a minimum stock of 76,874 (Ferrero et al., 2000).

Density estimates for the gulf range from about 0.277-0.514 porpoises per nautical mile (Consiglieri et al., 1982). They usually travel in groups of 10-20 animals. Larger groups containing more than 200 individuals have been reported; in 1980, a group of 3,000 was observed in Southeast Alaska (Leatherwood and Reeves, 1987; Consiglieri et al., 1982). Females were reported to have calving intervals of 1-3 years (Kasuya, 1978; Newby, 1982). Although adults with calves have been seen in spring in the North Pacific, most breeding and births probably occur from June to August with calving centered in early July (Ferrero and Walker, 1999; Newby, 1982). This porpoise is adapted for fast swimming speeds useful in rapidly attaining great depths that many of its preferred prey species are known to inhabit (Morejohn, 1979; Law and Blake, 1994). Dall's porpoises consume squid, crustaceans, and deepwater fish such as saury, hake, herring, and jack mackerel (Leatherwood and Reeves, 1987).

III.B.6.c(2) Killer Whales

The North Pacific killer whale population is regarded as abundant in the Gulf of Alaska/Cook Inlet region. More than 700 killer whales (orcas) have been identified in the gulf (Dalheim and Waite, 1992). The current minimum estimate of resident whales in the eastern North Pacific is 717 animals (Ferrero et al., 2000). In spring, killer whales are found throughout the gulf in shallow waters less than 200 meters deep (Braham and Dalheim, 1982). In summer, they apparently are more concentrated in the Kodiak Island area. The movement of resident killer whales (a pod or family group of whales that remains year-round within an area or territory such as in part of Prince William Sound) in nearshore waters—especially in summer and fall—is in part related to inshore migrations of pelagic fish, such as salmon and other shoaling fish, which are common prey species in these areas (Balcomb et al., 1980; Heimlich-Boran, 1988). In fall and winter, killer whales are numerous around Kodiak and in adjacent shelf waters but not elsewhere in the gulf (Consiglieri et al., 1982). Group or pod size varies from 1-100, but only 1% of these pods contain more than 20 whales (Braham and Dalheim, 1982). One aggregation estimated to contain 500 was recorded near Middleton Island in April 1972 (Consiglieri et al., 1982).

The peak breeding period is May through July (Nishiwaki and Handa, 1958, as cited by Consiglieri et al., 1982). A minimum calving interval recorded for female orcas in Washington and British Columbia was 3 years (Osborne and Heimlich-Boran, 1984). Other pods of nonresident or transient killer whales are believed to move over broader ranges of territory than do resident pods and prefer to feed on other marine mammals, such as seals; porpoises; dolphins; and beluga, sperm, and baleen whales (Pitman et al., 2001; Dahlheim and Towell, 1994; Heimlich-Boran, 1988; Barr and Barr, 1972; Hancock,1965). Known natural mortality rates of killer whales is very low at less than 5% and often as low as 1% (Braham and Barlow, 1991). However, in Prince William Sound, at least one pod of orcas (the AB pod) suffered a higher mortality rate of 7.4%, which was related to human interaction associated with the longline sable and blackcod fishery (Leatherwood et al., 1990). This same pod suffered additional losses (about 20% mortality) in 1989-1990 that may have been related to interactions with fisheries or the Exxon *Valdez* Oil Spill (Dahlheim and Matkin, 1994).

III.B.6.c(4) Minke Whales

The North Pacific minke whale population, including the Gulf of Alaska population, is categorized as abundant. However, there are no estimates available on the number of minke whales in Alaska (Ferrero et al., 2000). In spring, most minke whales are found throughout the OCS, especially in shallow, nearshore coastal waters. Minke whales are most abundant in the gulf during summer, when they appear to become more sedentary in their movements, sometimes occupying individual seasonal local feeding ranges (Dorsey, 1981). Concentrations of minke whales have occurred along the north coast of Kodiak Island and along the south coast of the Alaska Peninsula. Minke whales become scarce in the gulf in fall; most whales probably leave the region by October (Consiglieri et al., 1982).

The migratory patterns of the minke whale are not well defined. In the western North Pacific, there is no obvious migration from lower latitudes, and the species is found year-round in the Bering Sea (Horwood, 1990). Omura and Sakiura (1956) reported that in the western Pacific, minke whale sex and age segregation occurs during "migration." Adults and some adolescents travel to northernmost feeding areas, and most immature individuals remain in southern waters. Minke whales feed on a variety of small schooling fish and euphausiids by using lung-feeding or bird-associated feeding strategies (Nemoto, 1959, as cited by Consiglieri et al., 1982; Hoelzel, Dorsey, and Stern, 1989; Horwood, 1990).

III.B.6.c(5) Gray Whales

Since receiving protection by the International Whaling Commission in 1946, the eastern Pacific gray whale population has increased from a few thousand individuals that survived commercial harvest to more than 21,000 (Breiwick et al., 1989; Withrow, 1989; National Marine Fisheries Service, 1991a; Buckland et al., 1993). The current eastern Pacific stock estimate is 26,635 whales and a minimum of 24,477 animals (Angliss and Lodge, 2002). Evidence that the population is approaching or may have exceeded pre-exploitation levels (Rice, Wolman, and Braham, 1984) prompted the National Marine Fisheries Service to issue a determination that the eastern North Pacific stock be removed from the list of Endangered and Threatened Wildlife (59 *FR* 31094-31095).

Most gray whales calve and breed from late December to early February in protected waters along the western coast of Baja California. Recent observations suggest that some calving occurs as far north as Washington prior to arrival on the calving grounds (Dohl et al., 1983; Jones and Swartz, 1987).

Northward migration, primarily of individuals without calves, begins in February; some cow/calf pairs delay their departure from the calving area until well into April (Jones and Swartz, 1984). A majority of gray whales migrating through the southern California Bight follow routes near the mainland or Channel Islands and in the nearshore waters of coastal Mexico during both spring and fall migrations. Most whales occur within 15 kilometers of land but have been observed up to 200 kilometers offshore (Bonnell and Dailey, 1990). Much of the migration route north of Point Conception to and from summer feeding grounds in the northern Bering and southern Chukchi Seas lies within a few kilometers of the coast or adjacent islands. Gray whales approach the Cook Inlet Planning Area in late March, April, May, and June and again in November and December (Rice and Wolman, 1971; Consiglieri et al., 1982). Although there have been numerous sightings of gray whales in Shelikof Strait, most of the population follows the outer coast of the Kodiak archipelago from the Kenai Peninsula in spring or the Alaska Peninsula in fall (Map 16). Spring concentrations occur along eastern Afognak Island and the northeastern, central, and southeastern Kodiak Island area during the spring and fall migrations. Gray whale concentrations have been reported in Shelikof Strait, along the west side of Kodiak Island, during the fall.

The majority of the eastern Pacific gray whale population feeds primarily in the northern Bering and southern Chukchi seas during the summer months. Gray whale calf production appears to be influenced by the length of the open-water season in these primary feeding grounds (Perryman et al., 2002). A portion of the population summers and feeds along the eastern Pacific coast of California, Oregon, Washington, (Puget Sound), and British Columbia (Vancouver Island) (Sanchez-Pacheco, Vazquez-Hanckin, and De Silva-Davila, 2001; Avery and Hawkinson, 1992; Weilkamp et al., 1992; Mallonee, 1989; Kvitek and Oliver, 1986). Epibenthic and infauna amphipod crustaceans appear to be the primary prey species; polychaete worms, mollusks, and schooling fish also are taken (Mallonee, 1989; Sumich, 1984; Weilkamp et al., 1992; Kvitek and Oliver, 1986; Rice and Wolman, 1971). It is reasonable to speculate that similar feeding occurs along the Gulf of Alaska coast because, as the eastern Pacific population of gray whales recovered to its pre-exploitation level, the whales returned to using all benthic-prey resources available along the coast of its migration route and throughout its summer range.

III.B.6.c(6) Other Nonendangered Cetaceans

Other nonendangered cetaceans that rarely or infrequently occur in the Gulf of Alaska/Cook Inlet region include the short-finned pilot whale, Risso's dolphin, northern right whale dolphin, north Pacific giant bottlenose whale, goosebeak whale, and Bering Sea beaked whale (Consiglieri et al., 1982).

III.B.7. Terrestrial Mammals

Approximately 38 species of terrestrial mammals occur in the lower Cook Inlet region, with about 20 of these species present on the Kodiak Archipelago. Ten mainland species that use the marine coastal environments to some degree include the river otter, brown bear, black bear, red fox, arctic fox, wolf, coyote, mink, wolverine, and moose. In the Cook Inlet/Kodiak Archipelago area, the river otter, brown bear, and black-tailed deer use the coastal marine environment to a significant degree. A description of these species' use of coastal habitats in the lower Cook Inlet area follows.

III.B.7.a. River Otters

River otters frequently occur in nearshore waters all along the coast of the proposed sale area, where they forage on small fish, clams, crustaceans, and other invertebrates. They also use the beaches and intertidal areas. Sculpins and rockfish were reported to be predominant prey items of river otters occurring along the coast of southeastern Alaska (Larsen, 1984). River otters in Alaska breed in May, with mating occurring in and out of the water (Solf and Golden, 1994). One to six pups are born from late January to June. River otters reach sexual maturity at 2 years and live up to 20 years. Family units of an adult female and her pups, with or without an adult male, travel only a few miles. Larger groups of neighboring family units of more than 10 individuals form temporary associations. These groups travel over a wide area and apparently do not have exclusive territories (Solf and Golden, 1994).

III.B.7.b. Brown Bears

Brown bears are found throughout most of the Kodiak Archipelago and on all of the mainland adjacent to the proposed sale area. Brown bear densities are highest (more than 175 bears/1,000 square kilometers) on the Kodiak Archipelago and along the Alaska Peninsula and Kamishak Bay, with lower densities (50-175 bears/1,000 square kilometers) on the west side of Cook Inlet and more than 50 bears per 1,000 square kilometers on the Kenai Peninsula (Miller et al., 1997). The estimated brown bear population of Kodiak and adjacent islands is 2,800-3,000 animals, and the estimated density is 1.12 bears per square kilometers (Van Daele, 2001). The estimated brown bear population for the Alaska Peninsula in 1989 was 5,679 (Sellers, Trent, and Miller, 1991). The brown bear population of Katmai National Park recently was estimated at between 1,500 and 2,000 bears; the density along the coast of Katmai was estimated at 537 bears per 1,000 square kilometers (Sellers et al., 1993). Brown bears use the coastal areas from about April to November. During spring, bears rely heavily on coastal beaches, meadows, and shorelines while foraging on newly emergent plants, carrion, and intertidal infauna such as clams (see Map 17) during the summer and early fall, brown bears congregate along coastal streams to feed on salmon and other spawning fish (see Map 17). The salmon runs are especially important to the Kodiak, Alaska Peninsula, and McNeil River brown bears. The runs are available from late June to mid-December on Kodiak Island (Barnes, 1990). Female brown bears on the Alaska Peninsula generally are most productive between 9 and 16 years old, and litters of three cubs are more common there than in other areas; litters of four cubs are known to occur only on Kodiak Island and the Alaska Peninsula (Modafferi, 1984).

III.B.7.c. Sitka Black-Tailed Deer

Sitka black-tailed deer are found on Kodiak, Afognak, and Raspberry islands. The beaches and coastal areas are the primary winter range of this species. Between 1924 and 1934, a total of 25 Sitka black-tailed deer were translocated on Kodiak and Long Islands (Burris and McKnight, 1973, as cited by Van Daele, 2001). The deer population expanded into unoccupied habitat and, by the 1960's, deer were dispersed throughout Kodiak, Afognak, and adjacent islands (Smith, 1979, as cited by Van Daele, 2001). The population suffered declines due to severe winter snow conditions during the late 1960's and early 1970's. The population peaked at more than 100,000 deer in the mid-1980's and suffered its greatest decline due to severe winter conditions in 1997-1998. The current population is estimated at 40,000 deer, and the annual harvest is 8,000 (Van Daele, 2001). Deer concentrate on the outer capes along the coast during the winter where they forage on kelp (Calkins and Curatolo, 1979. During severe winters, the beach habitats sometimes provide most of the available food (Smith, as cited by Calkins, and Curatolo, 1979).

III.C. SOCIAL SYSTEMS

III.C.1. Economy

III.C.1.a. Revenues

III.C.1.a(1) Kenai Peninsula Borough

In the Kenai Peninsula Borough, for the year 1999, we estimate the valuation of all property to be $3.9 billion and the revenues from property tax to be $47 million. We use the year 1999 data, because it corresponds to the most recent year for which we have economic data in the employment and personal income forecast model we use in Section IV.B.1.j. Our estimate is based on Barnes (1993, pers. commun.) and changes in the Consumer Price Index (U.S. Department of Labor, Bureau of Labor Statistics as quoted in Fried and Windisch-Cole, 2001)). See Figure III.C-26 for the boundary of the Kenai Peninsula Borough.

Property tax collected is a function of the mill rate, which is a tax rate expressed in tenths of a cent. For example, a tax rate of one mill per thousand means $1 of taxes per $1,000 of assessed value. Mill rates vary from city to city and service area to service area in the unincorporated part of the Borough, but the average mill rate for the Borough as a whole is approximately 12 (Kenai Peninsula Borough, 1999). As an example, a mill rate of 12 on a $100,000 house would be .012 times $100,000 resulting in a property tax of $1,200.

Between 1966 and 2002, the State of Alaska allocated $6,346,000 for 29 projects under the Land and Water Conservation Program (http.//www.ahrino.org) 2002. In addition, under the Federal Coastal impact assistance program, the State of Alaska allocated $208,000 on a one-time basis to the Kenai Peninsula Borough (www.gov.state.ak.us.dgc/CIAP September 2001). These funds have been derived from OCS revenues. The latter program is intended in part to mitigate potential effects of OCS activities.

See Section IV.B.1.j(3) for an explanation of why we describe revenues of for the Kenai Peninsula Borough only and not the Lake and Peninsula Borough, Kodiak Island Borough, or Municipality of Anchorage.

III.C.1.a(2) State Revenues

The Federal Government made payments to the State of Alaska of $145,000 between 1997 and 2001, including bonuses and annual rentals, as a consequence of Federal leasing in Cook Inlet. These payments were made under provisions of the OCS Lands Act, referred to as 8(g), which require the MMS to pay the States 27% of all revenues derived from Federal leasing of offshore submerged lands lying between 5 and 10 kilometers (3 and 6 miles) from shore. Cook Inlet Sale 149 in 1997 resulted in a total of $254,000 in bonus bids and $51,000 in rentals per year, which are split between the State and the Federal Government according to the provisions of 8(g).

From 1986-2000, the Federal Government distributed to the State of Alaska a total of $505 million in revenues from leasing-related activities on the Alaska OCS. Between 1966 and 1995, the Federal Government allocated $20 million of OCS revenues through the Federal Land and Water Conservation Fund to the State of Alaska. The State, in turn, allocated these funds to local jurisdictions for eligible projects. In addition, Congress amended the OCS Lands Act to authorize the Coastal Impact Assistance Program, which makes a one-time allocation of $12 million to the State of Alaska. Of this, the State retains $8 million and allocates the balance to coastal political subdivisions according to a formula specified by the amended act (www.gov.state.ak.us/dgc/CIAP September 2001).

The State of Alaska revenues budgeted for expenditure varied between $3.7 billion in 1998 and $4.3 billion in 2001 (www.legfin.state.ak.us/BudgetReports/Operating/ 2002).

III.C.1.a(3) Federal Revenues

Between 1997 and 2001, the Federal Government received payments of $261,000, including bonuses and annual rentals, derived from Cook Inlet Sale 149. This is exclusive of payments to the State under provisions of the OCS Lands Act.

Total revenues from the Alaska OCS from 1976-2000 were $6.4 billion. Total Federal receipts of all types, including personal income tax, corporate tax, and other types of receipts, varied from $1.7 trillion in 1998 to $2.0 trillion in 2001 (www.whitehouse.gov/omb/budget/index.html, 2002).

III.C.1.b. Employment and Personal Income

III.C.1.b(1) History of Employment in the Kenai Peninsula Borough

For a history of employment in the Kenai Peninsula Borough, see the Cook Inlet Planning Area Oil and Gas Lease Sale 149 Final EIS (USDOI, MMS, Alaska OCS Region, 1995).

III.C.1.b(2) Current Employment in the Kenai Peninsula Borough

The Kenai Peninsula Borough economy is diverse, even more diverse than other parts of the State. Table III.C-1 illustrates the diversity of employment by major industry category. Retail employment expanded by 1,200 jobs, or 56%, between 1990 and 1998. Much of this expansion of retail trade is linked to the expansion in tourism on the Kenai Peninsula. This tourism includes visitors from outside the State as well as other parts of Alaska, especially Anchorage, which has almost half of the State's population. A similar expansion can be found in services.

The single largest visitor attraction on the Peninsula is sport fishing. For more information on recreation and tourism and on sport fisheries, see Sections III.C.5 and III.C.6.

Also important to the economy is commercial fishing, which is described in Section III.C.2.

The oil industry started in the 1950’s on the Kenai Peninsula and on the west side of Cook Inlet west of the Peninsula. Employment in this industry remained at a steady level of about 1,000 workers from 1990-1999 (Table III.C-2). In 2000, oil-industry employment took a sharp swing upward to about 1,600 workers average for the year. This probably was due to the work associated with gas exploration on the western shore of the Kenai Peninsula, north of Anchor Point, and the Osprey Platform in western upper Cook Inlet.

The Kenai/Soldotna area, the largest population center on the Peninsula, reflects the employment diversity of the Peninsula as a whole (Table III.C-3). Oil-industry employment (listed as mining in Table III.C-3) remained relatively constant over the 1990-1998 period, while retail trade expanded strongly and construction employment nearly doubled. The visitor industry also is strong. Homer employment is diverse, strong in commercial fishing, sport fishing, and tourism. Wage and salary employment by industry from 1990-1998 for the Kenai Peninsula Borough, Kenai-Soldotna area, and Homer area are given in Tables III.C-1, III.C-3, and III.C-4. Much of the information summarized above is from the State of Alaska, Dept. of Labor and Workforce Development, Research and Analysis Section, 2002 (www.labor.state.ak.us/research/region/kenai/kenstbl.htm) and Kenai Peninsula Borough (1999), which are incorporated by reference.

See Section IV.B.1.j(3) for an explanation of why we describe employment for the Kenai Peninsula Borough only and not the Lake and Peninsula Borough, Kodiak Island Borough, or Municipality of Anchorage.

III.C.1.b(3) U.S. Employment

U.S. employment in 1999 was 137 million (www.bea.doc.gov/bea/regional/ ,2002).

III.C.1.b(4) Personal Income

In 1999, aggregate personal income (according to www.bea.doc.gov/bea/regional/, 2002 was $1.2 billion for the Kenai Peninsula Borough and $7,739.4 billion for the U.S. See Section IV.B.1.j(3) for an explanation of why we describe personal income for the Kenai Peninsula Borough only and not the Lake and Peninsula Borough, Kodiak Island Borough, or Municipality of Anchorage.

Per capita personal income, rounded to the nearest thousand dollars, was $25,000 for the Kenai Peninsula Borough and $28,000 for the U.S.

III.C.1.c. Components of the Kenai Peninsula Borough's Economy

The population of certain villages in the Cook Inlet region is composed predominately of Alaskan Native people, who traditionally have relied on subsistence activities. Although not fully part of the cash economy, subsistence harvesting is important to the economy of these villages and even more important to their culture. Subsistence-harvest patterns and sociocultural systems are described in Sections III.C.3 and III.C.4. Other components of the Borough's economy are commercial fisheries, recreation and tourism, sport fisheries, and activities in national and State parks described in Sections III.C.2, III.C.5, III.C.6 and III.C.7, respectively.

III.C.2. Commercial Fisheries

The Alaska Department of Fish and Game divides Alaska's commercial fishing waters into four management regions (Figure III.C-1):

1. The Southeast Region (Southeast Yakutat),
2. The A-Y-K Region (Norton Sound/Kotzebue, Yukon, and Kuskokwim),
3. The Westward Region (Kodiak, Chignik, Alaska Peninsula, and Bristol Bay), and
4. The Central Region (Prince William Sound, Cook Inlet, and Bristol Bay).

There are numerous districts within these four regions, as shown on Figure III.C-2.

This section focuses on the Cook Inlet portion of the Central Region and, to a lesser extent, on the Kodiak, Chignik, and South Alaskan Peninsula portions of the Westward Region. Commercial fisheries in these waters include salmon; herring; groundfish (halibut, lingcod, rockfish, sablefish, pollock, and Pacific cod); and shellfish (crab, shrimp, scallops, and clams). Figures III.C-3 to III.C.5 show the commercial-fishing seasons and the types of gear used in Cook Inlet, Kodiak, Chignik, and South Alaskan Peninsula commercial fisheries. The combined ex-vessel value of these fisheries for all Alaskan regions in 2001 was estimated at $871 million (salmon: $216 million; herring: $10 million; halibut: $132 million; groundfish: $397 million; and shellfish: $117 million). Since the mid-1980's, the ex-vessel value of these fisheries in Alaska has been declining from a high of about $2.75 billion in 1988 to its current value in 2001 of $871 million (State of Alaska, Dept. of Fish and Game, 2002).

Each year, the four management regions and the primary fisheries within those regions contribute disproportionately to the overall value of the commercial fishery in Alaska. For example, in 1995 the value of the crab, shrimp, and miscellaneous shellfish landed in the Central Region was less than 1%, less than 4%, and less than 8%, respectively, of the State's total for shellfish (none coming from Cook Inlet). The value of the crab, shrimp, and miscellaneous shellfish landed in the Westward Region was 91%, less than 0%, and 18%, respectively, of the State's total for shellfish (State of Alaska, Dept. of Fish and Game, 1995). The value of the herring fishery landed in the Central Region was 53% of the State's total for herring (most coming from Bristol Bay and Prince William Sound), while landings in the Westward Region contributed 14% of the State's total. The value of Alaska's salmon fishery landed in the Central Region was 51% of the State's total for salmon (most coming from Bristol Bay and Prince William Sound), while the Westward Region contributed 25% of the State's total. The groundfish fishery in the Cook Inlet area is very limited and is estimated to have contributed less than 1% of the State's total value for groundfish for many years. The Kodiak and Chignik areas of the Westward Region are estimated to have contributed about 30% to the State's total groundfish value. The value of the halibut landed in the Central Region was 26% of the State's total for halibut (most coming from Cook Inlet) while landings in the Westward Region (most coming from Kodiak) contributed 14% of the State's total.

III.C.2.a. The Shellfish Fishery

Cook Inlet and the waters adjacent to Kodiak and Chignik have supported commercial shellfish fisheries for red king, tanner, and Dungeness crabs; the weathervane scallop; hard-shell clams; razor clams (Cook Inlet); shrimp and, in recent years, sea urchin and sea cucumber (Kodiak and Chignik). Due to low abundance levels in the Cook Inlet area, the fisheries for red king, tanner, and Dungeness crabs and for shrimp have been closed for some time. Only fisheries for the weathervane scallop and hard-shell and razor clams remain open in the Cook Inlet area. Due to low abundance levels in the Kodiak area, the red king crab commercial fishery has been closed since 1995. More extensive commercial fisheries for king and Dungeness crabs and other shellfish should occur again in future years as the stocks increase.

III.C.2.a(1) Crabs

Crabs are commercially caught using baited pots that usually are deployed in strings (lines) in large numbers. These pots have rebar metal frames with netting over them and with one or more biodegradable net panels to allow the catch to escape in the event the pot is lost. Pots may become lost when their buoys or other lines part or the buoys are sunk. This can be caused by a number of factors such as storms, other vessel traffic, and from marine mammal predation. The use of crab rings also is allowed to commercially harvest Dungeness crab and in some tanner crab fisheries. Pot soak time has declined over the years from several days to only 12 hours, as the length of the fishing season has been reduced. Female and undersized males are returned to the sea, and legal males are retained in live tanks or are processed immediately in the absence of live tanks.

In the Cook Inlet region, red king crabs have been commercially fished since the late 1930's, but catches were not recorded until the early 1960's. Most of the fishing occurred in the Southern or the Kamishak/Barren Islands districts (see Figure III.C-5). Catches peaked in the 1962-63 season, declined in the later 1960's, improved in the 1970's, but were terminated in the early 1980's when the red king crab stocks crashed in Cook Inlet. In the Kodiak area, red king crabs have been commercially fished since 1936, but catches were not recorded until the 1960-1961 season. Catches peaked at 42,834 metric tons in the 1965-1966 season, but declined to 3,960 metric tons by the final season in 1982-1983 in spite of management measures to prevent that from happening.

Catches in the tanner crab fishery in Cook Inlet have been recorded since 1968. The fishery occurred in all districts of Cook Inlet (except the Northern District) in addition to the outer and eastern districts (see Figure III.C-2). Catches peaked at 3,614 metric tons in the 1973-1974 season, but the fishery was closed in 1995 due to low abundance levels and has remained closed. However, a sport/personal-use fishery still occurs in the Southern District, which allows for harvests up to 10% of the legal male crabs. The fishery for tanner crab in the Kodiak area began in 1967, inspired largely by the declining red crab fishery in that area. The growth of the tanner crab fishery was slow at first due to slow consumer acceptance. By the early 1970's, the market grew significantly, and in the 1977-1978 season, the fishery peaked at 15,096 metric tons. The tanner crab fishery in the Kodiak area declined in the 1970's and 1980's, was closed in the 1993-1994 season, and has not been open since.

Catches for the Dungeness crab fishery in Cook Inlet have been recorded since 1961. Most of the catches occurred in the Southern District where they peaked in 1979 at 967 metric tons. The fishery in the Southern District has been closed since 1991 due to low abundance levels. In other districts, the Dungeness crab fishery has been closed since 1997 for the same reason. The sport/personal-use fishery also has been closed since mid-1998 due to low abundance levels. The fishery for Dungeness crab in the Kodiak area began in 1962 and peaked at 3,098 metric tons in 1968. Since then, stock abundance has fluctuated with changes in recruitment and fishing effort. Since 1995, weak market conditions have significantly reduced the amount of fishing effort for Dungeness crab in the Kodiak area.

III.C.2.a(2) Shrimp

The Cook Inlet and Kodiak commercial shrimp fisheries have included northern, sidestriped, coonstriped, spot, and humpy shrimp fisheries. Spot and coonstriped shrimp were harvested by pot gear at depths of 9 meters or deeper in Cook Inlet. Northern, sidestriped, and humpy shrimp are harvested by bottom-trawl gear. Northern shrimp are harvested in the Kodiak area with otter trawls operating in waters 20 meters or more in depth.

In the Cook Inlet area, shrimp have been commercially fished since 1915, but catches were not recorded until the 1950's. Most of the fishing occurred in the Southern District. Catches peaked during the 1980-1981 season at 2,802 metric tons, but trawl surveys indicated that shrimp abundances in the area had been declining since the 1970's. The shrimp fishery in lower Cook Inlet was closed in the 1987-1988 season, and has remained closed most of the time since then. Shrimp fisheries outside of Cook Inlet along the outer Kenai Peninsula are small by comparison but also were closed in the 1997-1998 season for the same reason. In the Kodiak area, the commercial shrimp fishery began in 1958. After recovering from the 1964 earthquake and the resulting tidal wave, catches peaked at 37,265 metric tons in 1971 (95% northern shrimp). Shrimp catches and fishing efforts declined significantly in the 1980's and 1990's due to low abundance and, by the 1998-1999 season, only 3 metric tons were landed in Kodiak.

III.C.2.a(3) Scallops

Weathervane scallops are harvested by vessels towing dredges mostly in waters 70-110 meters deep. Scallops are harvested commercially during some years, but these efforts have been limited until recently. The commercial fishery for weathervane scallops began in the Cook Inlet area in 1983. Catches have been sporadic and centered around a single scallop bed near Augustine Island in the Kamishak District of lower Cook Inlet, which has produced all of the catches since 1983 (Alaska Dept. of Fish and Game, 2000). The scallop catches and fishing effort peaked at 13 metric tons in 1996 but are set by regulation at 9 metric tons. The Kodiak fishery for weathervane scallops began in 1967, peaked at 643 metric tons in 1970, and declined to zero in 1977 and 1978. Since 1980 catches have fluctuated between 21 and 313 metric tons. Since the 1960's, a number of scallop beds off Kodiak Island have been closed due to a high bycatch rate of king and tanner crab and because the scallop dredges injure soft-shell crab.

III.C.2.a(4) Clams, Sea Cucumbers, and Sea Urchins

Other shellfish commercially fished in the Cook Inlet area include Pacific hard-shell and razor clams, sea cucumbers, and sea urchins. Most of the hard-shell clams harvested are Pacific little neck (mostly from Kachemak Bay) and butter clams. In the Kodiak and Chignik areas, other shellfish commercially fished include the red sea cucumber and the green sea urchin, both of which are harvested by hand by divers. Both fisheries began in the 1990's. The red sea cucumber fishery began in 1993, and the peak catch was 256 metric tons in that year. The catch declined drastically since then and has remained at 53-60 metric tons due to management restrictions. Off Kodiak Island, the green sea urchins are harvested for their roe. The fishery began in 1980, and the fishing effort has varied through 1999.

Management: The Alaska Department of Fish and Game manages the crab fisheries of the Cook Inlet, Kodiak, and Alaska Peninsula areas in cooperation with the National Marine Fisheries Service and the North Pacific Fishery Management Council. The State of Alaska is able to regulate the crab fisheries in Federal waters by providing that crab harvests landed in Alaskan ports must be taken in compliance with State management regulations. To ensure conservation of crab resources, seasons are established by the Alaska Department of Fish and Game, and, for some species, harvest quotas (limits) are set with coordination and in cooperation with the Federal fisheries agencies.

III.C.2.b. The Herring Fishery

Pacific herring are harvested annually in Cook Inlet in addition to the waters adjacent to Kodiak, Chignik, and the South Alaskan Peninsula. Gulf of Alaska herring are much smaller than those of the Bering Sea, and they do not live as long or migrate nearly as far. Herring are used mainly for their roe and sac-roe-on-kelp, which is marketed in Pacific Rim countries, and to a much lesser extent for food or bait, which is marketed in Alaska. Some carcasses are processed into fishmeal after the sac roe is removed. The fish itself is purchased by the ton, while roe-on-kelp is purchased by the pound.

The Alaska Department of Fish and Game divides Cook Inlet into upper and lower management districts, each with a different management team, and each with their own districts and subdistricts (see Figures

III.C-6 and III.C-7). In the upper Cook Inlet area, commercial herring fishing began in 1973. Harvests have averaged well under 400 tons a year (less than $200,000 ex-vessel value), which makes it one of the smallest herring fisheries in the state. Gill nets currently are the only legal gear for herring in upper Cook Inlet, with setnets being used almost exclusively. There are three primary fisheries in the upper Cook Inlet area: the eastside, the Chinitna Bay, and Tuxedni Bay fisheries. Due to low stock abundance, all of these were closed to fishing by 1993. In 1998 the eastside fishery was reopened from April 15 to May 20, but for only 2 days a week. Since 1998, the ex-vessel value of the upper Cook Inlet fishery has dropped to less than $20,000 a year.

In the lower Cook Inlet area, commercial herring fishing began in 1914 with the development of a gillnet fishery in Kachemak Bay. A purse seine fishery developed there in 1923 but by 1926, the herring population and the fishery had collapsed. The next lower Cook Inlet herring fishery began in 1939 in the eastern district, which is farthest from lower Cook Inlet and is centered in Resurrection Bay. It ended in 1959 when stocks declined, apparently due to overexploitation. Due to Japanese market demand, a sac roe herring fishery developed in lower Cook Inlet in the 1960's. However, from 1961-2001, the southern, eastern, and outer districts were either not fished or were closed much of the time due to low stock abundance. Since 1973, most lower Cook Inlet sac roe harvests have occurred in the Kamishak Bay district where abundances were higher. Harvests have ranged from 243 tons in 1973, to a high of 6,132 tons in 1987. From 1973-1998, ex-vessel valves in the Kamishak Bay district have ranged from $70,000-$9,300,000. Due to low stock abundance, the Kamishak Bay fishery was closed in 1980 but was opened again in 1985, when stocks improved. However, the Kamishak Bay fishery was closed again in 1999 for the same reason and has remained closed.

The Kodiak Management Area (Figure III.C-8) has two commercial herring fisheries: a spring sac roe fishery and a fall food and bait fishery. The first commercial herring fishery in the Kodiak Management Area began in 1912 with the development of a food and bait fishery. From the late 1920's to the late 1950's, this fishery switched to reduction products such as fishmeal and oil. Most of the harvests from 1912-1959 ranged from 2,000-60,000 tons with many years above 20,000 tons. From the early 1960's to present, harvests in the Kodiak Management Area food and bait fishery have been much reduced. Most harvests since 1960 have been less than 500 tons, and several years were either closed or no harvests were reported. Gear used in the food and bait fishery includes midwater trawl, gillnet, and seine. Since 1964, the primary commercial herring fishery in the Kodiak Management Area has been the sac roe fishery. Gear used in this fishery has included trawls, seines, and gillnets. Trawls and beach seines were made illegal in 1981, and additional restrictions have been placed on seines and gillnets in the years since then. From 1964-2001, sac roe herring harvests in the Kodiak Management Area have averaged 1,921 tons, with an ex-vessel value high of about $6,800,000 in 1996 and a low of $800,000 in 1998. The ex-vessel value of the Kodiak Management Area sac roe harvest in 2001 was $847,000, the fourth lowest in the history of the Kodiak Management Area fishery.

Commercial herring fishing in the Alaska Peninsula-Aleutian Islands Management Area (see Alaska Peninsula on Figure III.C-8) began in 1929 with the development of a food and bait fishery (commonly referred to as the Dutch Harbor food and bait fishery). From 1929-2001, most harvests ranged from 1,000-3,500 tons. No fishing occurred from 1939-1944 or from 1946-1980. The fishery is conducted only in the Unimak, Akutan, Unalaska, Umnak, and Adak districts; however, in recent years, all harvests have been from Unalaska Bay in the Unalaska District. Since 1982, ex-vessel values for the food and bait herring fishery have ranged from $1,020,000 in 1982 to a low of $287,000 in 1990, but increased again in 2001 to $406,000. A herring sac roe fishery also occurs in the North and South Peninsula districts of the Alaska Peninsula-Aleutian Islands Management Area. The gear used in the sac roe fishery (and the food and bait fishery) consists of gillnets and seines. The North Peninsula fishery has occurred annually since 1982, with the exception of 1997 and 1999-2001 when there were no harvests due to poor market conditions and low stock abundance. During the period when fishing occurred (1979-1995), sac roe harvests in the North Peninsula fishery averaged about 800 tons. At $300 a ton, this represents an ex-vessel average value of about $240,000 per year. The South Peninsula sac roe fishery has occurred annually since 1979, with the exception of 1983 when the harvest was allocated to the food and bait fishery, and 1997-1999, and in 2001 when there were no harvests due to poor market conditions and low stock abundance. During the period when fishing occurred (1980-1995), sac roe harvests in the South Peninsula fishery averaged about 950 tons. At $300 a ton, this represents an ex-vessel average value of about $285,000 per year.

Management: The management of herring stocks in the Cook Inlet, Kodiak, and the Alaskan Peninsula areas is carried out by the Alaska Department of Fish and Game and the Alaska Board of Fisheries, an appointed body. The Alaska Department of Fish and Game has management jurisdiction for herring fisheries extending from shore to 3 miles offshore. The North Pacific Fishery Management Council has management jurisdiction extending from 3 miles offshore to 200 miles offshore. The Alaska Department of Fish and Game has the authority to impose emergency closures and other management actions to conserve all Alaskan herring populations within the 3-mile limit. For sac roe fisheries, Alaska Department of Fish and Game times herring openings to occur when herring have produced the maximum amount of roe. Seasons and management regulations are reviewed periodically and published annually by the Alaska Department of Fish and Game. Entry into most herring fisheries in Alaska is limited under the authority of the Commercial Fisheries Entry Commission. Federal regulations preclude retention of herring bycatch harvested in trawl fisheries.

III.C.2.c. The Salmon Fishery

In Cook Inlet and the waters adjacent to Kodiak, Chignik, and the southern Alaska Peninsula, all five species of Pacific salmon are harvested commercially (as well as for subsistence and sport). Second only to Alaska's groundfish fishery, Alaska's salmon fishery is one of the largest fisheries in volume and value. Salmon fisheries in Shelikof Strait and near Kodiak Island are closely equivalent to those in Cook Inlet, with slightly different fishing seasons and periods. Cook Inlet and Kodiak salmon fisheries use purse seines, drift gillnets, set gillnets and, in small numbers, beach seines. The regional salmon fisheries commence in early May and continue well into September each year.

Purse seines are long nets played into the water from the vessel as it travels in a large circle. A dory is positioned at the end of the net and, when the circle is nearly complete, the end is brought up to the vessel. The net balloons out to encircle a school of salmon, after which the net is pulled closed (pursed) at the bottom, trapping the fish. The seine and its catch are then hoisted aboard the vessel. Purse seines are most efficient in catching pink, chum, and sockeye salmon, species that congregate in large schools. Drift gillnets are deployed from the fishing vessel and fish at some depth but well off the bottom, held in position by lead lines and floats. They may drift with the tide or be maneuvered by the fishing vessel. The salmon are enmeshed by their gills as they attempt to pass through the net. After a period of time, the net is reeled aboard and the salmon removed. Set nets, as named, are fixed gillnets that usually are fished nearshore and also enmesh migrating salmon. The net may then be beached or a small skiff used to remove the catch. Beach seines have limited use in the Cook Inlet and Shelikof Strait region. These nets are deployed from shore, and a boat is used to attempt to encircle salmon, after which the seine is beached.

In recent years, the combined ex-vessel value of commercially harvested salmon in Alaska has been declining from a high of 487 million in 1995 to a low of 216 million in 2001. This trend also has occurred in the Cook Inlet, Kodiak, Chignik, and the South Alaskan Peninsula areas. The ex-vessel value of salmon landed in Cook Inlet during this time ranged from a high of 35.2 million in 1997 to a low of 8.8 million in 2001. In Kodiak the ex-vessel value of salmon ranged from a high of 53.9 million in 1995 to 18.9 million in 2001 (State of Alaska, Dept. of Fish and Game, 1996d). Sockeye are commercially harvested in much greater numbers in upper Cook Inlet than in lower Cook Inlet. Due to the pink salmon hatcheries in lower Cook Inlet, pink salmon are commercially harvested in much greater numbers there than in upper Cook Inlet. Because of this, and the fact that commercially harvested sockeye sell for 5-7 times that of pink salmon, upper Cook Inlet accounts for most of the ex-vessel value for salmon within the Cook Inlet area. For example, in 1995, the value of commercially harvested salmon in the upper Cook Inlet Management area (Figure III.C-6) was estimated at about 22 million (State of Alaska, Dept. of Fish and Game, 1996b), whereas the value of commercially harvested salmon in the lower Cook Inlet Districts (Figure III.C-5) was estimated at about 2.76 million (State of Alaska, Dept. of Fish and Game, 1996:3).

Management: The management of salmon stocks in the Cook Inlet, Kodiak, and the Alaskan Peninsula areas is carried out by the Alaska Department of Fish and Game and the Alaska Board of Fisheries, an appointed body. The seasons are set and the salmon fisheries are managed intensively for conservation. Within a fishing season, there are closed periods to allow for adequate spawning escapements, usually over weekends. Additionally, when spawning escapement numbers are low, the Alaska Department of Fish and

Game has the authority to impose emergency closures and other management actions to increase the number of salmon reaching the spawning grounds. Seasons and management regulations are reviewed periodically and published annually by the Alaska Department of Fish and Game.

III.C.2.d. The Groundfish Fishery

Groundfish are commercially harvested in all four Alaska Department of Fish and Game commercial fishing regions. This includes the Cook Inlet area of the Central Region, and the Kodiak, Chignik, and the South Alaskan Peninsula waters of the Westward Region. The groundfish fishery is the largest commercial fishery in Alaska by volume and value. Most Alaskan groundfish are landed in the Bering Sea/Aleutian Islands area of the Central region outside the sale area. Commercially harvested groundfish of the Central and Westward Regions have included, but are not limited to, rockfish (numerous species), flatfish (including halibut), pacific cod, lingcod, sablefish, and pollock. One or more of these fisheries may operate during most of the year in the proposed multiple-sale area and in the Kodiak, Chignik, and the South Alaskan Peninsula fisheries south of the sale area. Some species landed as bycatch include spiny dogfish, Pacific sleeper shark, Pacific salmon shark, majestic squid, giant Pacific octopus, and various species of skates. Although the Alaska Department of Fish and Game manages halibut separately from groundfish, halibut is a groundfish and has been included here to avoid confusion.

Groundfish are harvested with trawls, pots, longlines, and small sunken gillnets. The trawls used to catch groundfish are similar in construction to those used in the shrimp fishery; however, they are much larger and are fished differently. Bottom trawls employ heavy panels (doors) and chains to maintain depth and position during trawling. The usual vessel for these trawl fisheries is the stern trawler, where the trawl net is deployed from the stern of the vessel and tows may cover many miles while conducted over extended periods. Larger trawl vessels have onboard processing capability and may remain fishing for 2-3 months before returning to port.

The lower Cook Inlet and Kodiak/Shelikof Strait longline fishery primarily harvests sablefish (black cod), Pacific cod, and halibut. Longlines have a large number of leaders (ganglions) with baited hooks and are strung over long distances along the seafloor. Lines are anchored and buoyed and allowed to fish for several hours before retrieval. An increasing number of fishermen now use small pots to harvest sablefish and cod; and some effort has been directed toward the use of sunken gillnets to harvest some groundfish.

Groundfish landings and ex-vessel earnings in the Cook Inlet area for sablefish, rockfish, lingcod, Pacific cod, pollock, and other species have varied substantially over time. Landings in 1988 totaled 897,013 pounds (ex-vessel value of $279,965) but increased considerably in 1991 when they jumped to 2,346,558 pounds (ex-vessel value of $635,719). Since 1991, landings increased to 13,434,633 pounds in 1998 (ex-vessel value of $1,729,404), but declined to 1,698,971 pounds in 2001 (ex-vessel value of $842,055) (State of Alaska, Dept. of Fish and Game, 2001:Table 1). Halibut is the major commercial groundfish fishery in the Cook Inlet area with landings (Homer, Kenai, Ninilchik, Seldovia, and Seward) totaling 15,346,912 pounds in 2000, and 19,787,911 pounds in 2001 (Figure III.C-3). At $2.60 per pound (the minimum price that year), this represents an ex-vessel value of at least $51,448,568 in 2001. More than 30% of the total Cook Inlet halibut harvest in 2000 and 2001 was landed in Seward, which is in the Eastern District of the lower Cook Inlet Management Area. Due to low stock abundance, the 2002 Cook Inlet fishery for pollock is closed, except for bycatch. For the same reason, the sablefish, rockfish, and lingcod fisheries of the Cook Inlet area are subject to short seasons, emergency orders, gear restrictions, trip limits, restricted fishing locations, parallel or directed fishery restrictions, or several of the above. The 2002 Cook Inlet fishery for Pacific cod is bycatch only for longline gear, but is open to pot and jig gear (with some conditions).

Except for halibut, groundfish landings and ex-vessel earnings in the Kodiak, Chignik, and the South Alaska Peninsula fisheries are much higher than those of the Cook Inlet area and include more species. From 1988-2001 the ex-vessel value of the Kodiak groundfish fishery (excluding halibut) ranged from a low of $15,838,460 in 1989 to a high of $40,983,750 in 2000. The ex-vessel value of the Chignik groundfish fishery ranged from a low of $1,056,366 in 2001 to a high of $6,290,632 in 1991, and the South Alaskan Peninsula groundfish fishery ranged from a low of $3,189,992 in 1993 to a high of $21,741,956 in 2000 (State of Alaska, Dept. of Fish and Game (Kodiak), pers. commun.). The combined groundfish landings of Kodiak, Chignik, and the South Alaskan Peninsula were 81,121,861 pounds in 2000 (more than 95% were Pacific cod and pollock) (State of Alaska, Dept. of Fish and Game, 2001:Table 2). The combined ex-vessel value of the groundfish fishery (excluding halibut) in this portion of the Westward Region was $65,531,787 in 2000, and $45,762,618 in 2001 (State of Alaska, Dept. of Fish and Game, 2002 (Kodiak), pers. commun.). Halibut landings in the Kodiak and Chignik areas totaled 9,677,932 pounds in 2000, and 8,993,840 pounds in 2001 (Figure III.C-3). The $2.40 per pound (the estimated average for 2001) represents an ex-vessel value for halibut of about $21,585,216 in 2001.

Management: The Alaska Department of Fish and Game and the National Marine Fisheries Service share and coordinate management responsibilities for Alaska's groundfish fisheries. The Alaska Department of Fish and Game has management jurisdiction for groundfish stocks extending from shore to 3 miles offshore (commonly referred to as State waters). The Alaska Department of Fish and Game also has management jurisdiction for lingcod and black rockfish fisheries to 200 miles offshore. The Alaska Department of Fish and Game manages all commercial groundfish fisheries within the Cook Inlet Area. However, most of the groundfish fisheries off the Alaskan coast fall under National Marine Fisheries Service management jurisdiction, which begins 3 miles offshore and ends 200 miles offshore (commonly referred to as the Exclusive Economic Zone). Fishery Management Plan's are developed by the North Pacific Fishery Management Council to manage the Exclusive Economic Zone. The National Marine Fisheries Service, North Pacific Fishery Management Council, and the International Pacific Halibut Commission establish seasons for each groundfish species and harvest quotas called the Total Allowable Catch. Because the commercial-fishing effort cannot completely discriminate, some nontarget species are also caught, for example, halibut taken in the pollock-trawl fishery. This bycatch must be released, and in some fisheries, bycatch becomes a limiting factor to that fishery when its season is suddenly closed due to a bycatch limit being reached.

III.C.2.e. Fish Hatcheries and Aquatic Farms

The Alaska Department of Fish and Game oversees and regulates all State and private sector salmon rehabilitation and enhancement projects (State of Alaska, Dept. Fish and Game, 2003). More than 1.8 billion salmon eggs were collected by Alaska hatchery operators in 2002. In addition, more than 1.4 billion fish were released, and nearly 26 million fish were harvested in common-property fisheries as a result of the ocean-ranching program. The ocean-ranching program provides hundreds of Alaskans with seasonal and full-time jobs. It is now considered the largest agricultural industry in Alaska.

Prince William Sound and Southeast Alaska are the predominant regions affected by the enhancement program, and pink and chum salmon are the predominant species produced. Hatcheries in Cook Inlet supporting the ocean-ranching program are located at Port Graham, Tutla Bay, Elmendorf, and Fort Richardson. Hatcheries in the Kodiak region are located at Kitoi Bay and Pillar Creek.

The salmon-enhancement program is composed of several factions: 2 state hatcheries; 29 private, nonprofit corporation hatcheries; 2 Federal hatcheries; and several streamside incubation and restoration projects. Contributions to harvests from the five Prince William Sound hatcheries provided nearly $14 million to common-property fishermen, approximately 53% of the ex-vessel value. Nearly half of the hatchery contribution number and more than half of the value was sockeye salmon. More than 22% of the common-property sockeye salmon caught in Cook Inlet commercial salmon fisheries originated from Cook Inlet hatcheries, with a preliminary ex-vessel value of $2.5 million. Approximately 36% of the common-property harvest in Kodiak commercial salmon fisheries was enhanced salmon with a combined ex-vessel value of $4.1 million. The largest proportion of the 7.6 million hatchery fish harvested was pink salmon; however, the largest proportion of the ex-vessel value was sockeye salmon.

In 1988, the Alaska Legislature changed the State's aquatic farming laws to allow shellfish and sea-plant farming on all State land except parkland. Additional changes were made in 1997 that allowed the Alaska Department of Natural Resources to enter directly into a lease for an aquatic farm site. An aquatic farm lease is a 10-year property right granted by the Department of Natural Resources that allows a lessee to develop the State's tide and submerged lands into a shellfish or sea-plant farm. Currently, finfish farming is not allowed in Alaska.

Fish hatcheries and aquatic farms in the Cook Inlet and Kodiak Island regions are plotted on Map 21.

III.C.2.e. Fishermen’s Contingency Fund

Commercial-fishing gear sometimes is damaged, destroyed, or lost as a result of oil and gas operations on the OCS. Some compensation laws have been established over the years to protect fishermen from certain occupational risks that could relate to offshore oil production. These include the Alaska Fisherman’s Fund, the Oil Spill Liability Trust Fund, and the Fisherman’s Contingency Fund. The Fisherman’s Contingency Fund is the most relevant, because it pays commercial fishermen for damaged gear and other economic losses caused by oil and gas obstructions in Federal waters where damage is not attributable to a single entity. The regulations (50 CFR Part 296) establish procedures for administering the fund and for filing, processing, reviewing, adjudicating, and paying claims. There are, however, a number of qualifications. Most significantly, Federal regulations require claimants to prove that damages have resulted from underwater obstructions related to offshore oil and gas activities. Any structure visible on the surface of the water that could be avoided by a prudent fisherman does not qualify as an “obstruction.” In fact, any damage that occurs within a quarter-mile radius of any charted surface obstruction (such as an oil platform) is ineligible for compensation. No claims have ever been filed from the Alaska OCS region and, therefore, oil and gas companies in the area do not currently pay annual assessments into the fund.

III.C.2.f. Individual Fishing Quota System

The United States Secretary of Commerce approved the Individual Fishing Quota system for fixed-gear fisheries for halibut and sablefish in the North Pacific. The system went into effect in spring 1993, and actual operations began January 1, 1995. The purpose of the Individual Fishing Quota system was to end, equitably and fairly, the short, intensive openings for these two species; diminish pressure on the halibut and sablefish; and allocate fishing privileges to those who have invested in the fisheries and showed a dependence on the resources. Prior to the Individual Fishing Quota system, the large number of boats coupled with short openings often resulted in a dangerous fishery for commercial fishermen, and openings were not altered due to bad weather.

Additionally, the derby-style fishery resulted in large numbers of fish being harvested in relatively short periods of time. This tended to flood the market with fish, which often reduced the price paid to commercial fishermen. In the last decade, fish farming added to this situation by adding more fish to the market (previously dominated by commercial fishermen). However, since the implementation of Individual Fishing Quotas, commercial fishing for halibut and sablefish is now conducted over much longer periods. This permits the harvester to select more favorable weather for harvesting operations. It also permits commercial fishers to do their harvesting at a time when they can obtain maximum market prices. This reduces the number of halibut and sablefish that are available during any one period of time and reduces the need to freeze fish for later delivery to the market, which means the market has fresh, commercially harvested fish over much longer periods (8 months for halibut) than was possible prior to Individual Fishing Quotas. In addition, this allows more time and care in the harvesting and processing operations.

The downside of this is that the consumer pays much higher prices for fish than they did prior to Individual Fishing Quotas (a subject given very little to no attention during the push for Individual Fishing Quotas). In fact, prior to Individual Fishing Quotas and fish farms, fresh ocean fish was one of the least expensive meats available to consumers; today, it has become one of the most expensive. While inflation has contributed to this, the primary reason is that several of the key market-fish species (namely halibut, sablefish, and salmon) no longer flood the commercial market (thereby keeping prices down) as they did prior to the advent of Individual Fishing Quotas and fish farms. Individual Fishing Quotas allow the commercial-fishing industry (and those regulating it) to better control the availability (i.e., the supply) of any commercially harvested fish that they apply to (currently halibut and sablefish). Fish farms, which are a major player in the world fish market today, can do even more to control supply. Because they are not limited by fishing seasons or catch allotments, they can farm and harvest any economically marketable species, and they can take advantage of changing market opportunities (primarily due to far less government regulation). Hence, by controlling supply, Individual Fishing Quotas and fish farms have become major factors in controlling market demand, which has dramatically increased the consumer price of fish.

For example, ex-vessel prices for sablefish from 1988-1994 varied from $.48-$1.38 a pound with an average price for that period of $.81 a pound. However, in 1995 (the year Individual Fishing Quotas were implemented), ex-vessel prices for sablefish jumped suddenly to $2.06 a pound and averaged $1.87 from 1995-2001. That more than doubled the average price paid to commercial fishermen for sablefish, which is now being paid by end consumers. The same is true concerning halibut Individual Fishing Quotas. During most of the period from 1980-1993 (prior to Individual Fishing Quotas), ex-vessel halibut prices ranged from $.75-$1.25 a pound, which is about half that of 2001 prices ($2.60 a pound in Homer). During the pre-Individual Fishing Quota period, retail consumers typically paid $1.00-$4.00 a pound for fresh halibut. However, since Individual Fishing Quotas went into effect, retail consumers have been paying from $5.00-11.00 a pound for fresh halibut. While Individual Fishing Quotas apply only to halibut and sablefish (other fish species are now being considered), they also contribute to increased consumer prices on other market fish. By controlling the supply of two key market species (halibut and sablefish) and, thus, the consumer price, the market demand for other species (including beef and poultry) also is increased, which also increases the price of those species (including fish). For example, prior to Individual Fishing Quotas, the retail price for fresh salmon (coho, red, and king) ranged from $2.00-$4.00 a pound. However, since the implementation of Individual Fishing Quotas, the retail price for fresh salmon now ranges from $5.00-11.00 a pound. In 2001, ex-vessel prices for king salmon ranged from $4.00-$5.00 a pound for most of the season in Alaska (roughly twice that of the pre-Individual Fishing Quota era) and, in Seattle, retailed for as much as $15.99-$17.99 a pound. Farmed salmon typically retail at the lower end of the scale, closer to $5.00, whereas commercially harvested wild salmon typically retail for $5.00-11.00 a pound.

Fish consumers are not the only economic casualty of Individual Fishing Quotas. Both the halibut and the sablefish processing sectors in Alaska have also been substantially impacted. According to a recent State of Alaska study, it was estimated that more than 82% of the halibut-processing sector and 97% of the sablefish processing sector have lost revenues since the implementation of Individual Fishing Quotas. In this regard, the study makes the following statements:

> The switch from open access to individual transferable quota management is generally regarded a resounding success because efficiency losses emanating from open access externalities are recaptured. But past analysis of transferable quota policies stop there. There has been little theoretical work and no empirical analysis of who wins, and who loses and how much….
>
> The empirical evidence provided by this study supports the theoretical arguments that a harvester-only allocation of quota transfers wealth from processors to harvesters [commercial fishermen].

Regarding the loss of revenues now occurring within the processing sector, the report goes on to make the following conclusions:

> Despite the 96% increase in total revenues to the entire industry [due to Individual Fishing Quotas], the pre-Individual Fishing Quota processing sector [for halibut] is estimated to have lost, on average, 56.1% of its pre-Individual Fishing Quota revenues in excess of variable costs….
>
> The processing sector [halibut and sablefish processing sectors] lost, on average, 75% of their pre-Individual Fishing Quota revenues in excess of variable costs.

While the commercial fishing industry and fish farms compete to supply the market with fresh fish, it should be remembered that Individual Fishing Quotas apply only to halibut and sablefish (black cod), and farmed ocean fish includes only salmon (primarily Atlantic salmon). The multitude of other ocean fish and shellfish has always been, and continue to be, available to the consumer as either fresh or frozen fish or shellfish. Prior to the advent of Individual Fishing Quotas and fish farms, the quality of fish and shellfish (including halibut, sablefish, and salmon) was already high at the consumer level and, at any time during the year, many species were available as fresh fish or shellfish. Therefore, the only benefit of Individual Fishing Quota and farmed fish to end consumers is that they make a few species (halibut, black cod, and Atlantic salmon) available as fresh fish more often. However, due to the size and diversity of the seafood market prior to Individual Fishing Quotas and the already high quality of fresh fish and shellfish in that market, this benefit has not had a perceptible impact on most consumers. The opposite is true concerning the huge retail price increases generated by the Individual Fishing Quota marketing strategy. In fact, Individual Fishing Quotas have altered the pre-Individual Fishing Quota consumer base in terms of who remains capable of purchasing ocean fish and shellfish, and how much (if any) they continue to purchase. It also is noteworthy that wild, commercially harvested salmon are harder to find today due to the increasing volume of hatchery-raised and farmed-raised fish on the market. As fish farms and fish hatcheries continue to increase in number, and as the number of species they produce also increases, the percentage of wild fish on the market is likely to be further reduced.

III.C.3. Subsistence-Harvest Patterns

IIII.C.3.a. Characteristics of Harvest Patterns

This description provides general information on the following subsistence-harvest patterns, harvest information by resource and community, timing of the subsistence-harvest cycles, and harvest-area concentrations by community. Subsistence hunting, fishing, and trapping occur year-round throughout the entire region. Subsistence foods include salmon, other fish, big game, small game and furbearers, marine mammals, birds and eggs, marine invertebrates, and plants and berries. The harvest and use of these foods represent activities with significant social and cultural meaning as well as economic importance, especially within Alaskan Native communities. Subsistence activities tie the community together and provide group identity and community stability. This section describes the subsistence-harvest patterns of the Alutiiq, Koniag, and Athabascan communities adjacent to the Cook Inlet multiple-sale area. The following summary description is augmented by information from current studies, including S.R. Braund and Assocs. (1982); Wolfe and Ellanna (1983); Fall, Foster, and Stanek (1984); Reed (1985); Stanek (1985); USDOI, MMS, Alaska OCS Region (1995); Fall and Utermohle (1999); State of Alaska, Dept. of Natural Resources (1999); and Fall et al. (2000).

III.C.3.b. Definition of Subsistence

Generally, subsistence is considered hunting, fishing, and gathering for the primary purpose of acquiring food. The Alaska National Interest Land Conservation Act defines subsistence as the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter or sharing for personal or family consumption; and for customary trade (16 U.S.C. § 3113). For example, on Alaska's North Slope, the North Slope Borough Municipal Code defines subsistence as an activity performed in support of the basic beliefs and nutritional needs of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities (North Slope Borough Municipal Code 19.20.020(67)). As a lifestyle for Native Alaskans, subsistence is more than the harvesting, processing, sharing, and trading of marine and land mammals, fish, and plants. Subsistence should be understood to embody cultural, social, and spiritual values that are the essence of Alaskan Native cultures (Bryner, 1995; State of Alaska, Dept. of Natural Resources, 1997).

Many of the communities adjacent to the Cook Inlet multiple-sale area participate in a subsistence way of life. While new elements have been added to the way people live, this way of life is a continuation of centuries-old traditional patterns. Until January 1990, Alaska statutes defined "subsistence uses" as "the non-commercial, customary and traditional uses of wild, renewable resources by a resident domiciled in a rural area of the state for personal or family consumption" (Alaska Statute § l6.05.940); and subsistence uses were given priority over other uses. In January 1990, as a result of *McDowell vs. State of Alaska*, this law was declared unconstitutional by the Alaska Supreme Court. However, Federal law (Title VIII of Alaska National Interest Land Conservation Act) continues to define Alaskan subsistence and grants it priority over other uses. The new ruling means Alaska cannot legally (according to State law) establish rural preference for subsistence. The effect of the Alaska Supreme Court's decision was stayed until July 1, 1990. The State had until then to devise a solution to the issues raised in the *McDowell* decision. The Alaska State Legislature has not passed any subsistence legislation, despite a number of special sessions convened for that purpose initiated by the Governor. On Federal lands and navigable waters in Alaska, Federal laws grant subsistence priority over other uses, and Federal Agencies are now managing these subsistence harvests and will continue to do so until State legislation can be enacted (USDOI, Fish and Wildlife Service, 1992). Spurred by a number of recent court decisions and the State of Alaska's failure to enact a subsistence plan that guarantees some type of rural preference, the management of subsistence fisheries on Federal lands is now under the auspices of the Fish and Wildlife Service (Hulen, 1996).

III.C.3.c. The Cultural Importance of Subsistence

Subsistence activities are assigned the highest cultural values by local Cook Inlet Dena'ina, Kenaitze, Alutiiq, and Koniag Native harvesters and provide a sense of identity in addition to being an important economic pursuit. Many species are important for the role they play in the annual cycle of subsistence-resource harvests, yet effects on subsistence can be serious, even if the net quantity of available food does not decline. Subsistence resources provide more than dietary benefits. They also provide materials for personal and family use, and the sharing of resources helps maintain traditional family organization. Subsistence resources also provide special foods for religious and social occasions. The sharing, trading, and bartering of subsistence foods structures relationships among communities while at the same time, the giving of such foods helps maintain ties with family members elsewhere in Alaska.

Kinship ties affect the entire range of activities of harvesting, processing, distribution, and exchange of fish and game. Facilities and equipment such as fish camps, nets, vehicles, and smokehouses are commonly shared, and wildlife resources are widely distributed within and between villages. Traditionally, the harvester shares resources with elderly or sick recipients who do not have the means to harvest products themselves. Resources are also shared at potlatches and during special social events such as weddings, birthdays, and funerals (State of Alaska, Dept. of Natural Resources, 1999; Borass, 2002).

III.C.3.d. Regional Traditional Knowledge on Subsistence

Following are listed responses by local residents and subsistence hunters of coastal communities in the Cook Inlet, Kenai Peninsula, Kodiak Island, and southern Alaska Peninsula regions. The primary sources for the local and traditional knowledge in the following come from the Alaska Traditional Knowledge and Native Foods Database, Native Concerns, gathered in a series of regional workshops for the Environmental Protection Agency-funded Traditional Knowledge and Contaminants Project conducted by the Alaska Native Science Commission and The Institute of Social and Economic Research, University of Alaska Anchorage. Interviews began in 1998 and have been conducted at regional talking circles. Release forms were signed by all interviewees before the interviews were posted on the web site; the project and the regional talking circles are ongoing (http://www.nativeknowledge.org/db/concerns.asp). The other primary source used is the Whiskers! database, a multicultural multimedia database of indigenous local knowledge about Alaskan marine mammals compiled by the Department of Fish and Game in 65 Alaskan coastal communities between 1992 and 1998 (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(1) Central Kenai Peninsula

III.C.3.d(1)(a) Kenai

The following lists responses from Kenai Peninsula residents.

Some believe there is no traditional season for seal hunting for food; instead, whenever they need or want seal for food, they go out. But when harvesting seals for hides as well as food, they go when the water turns cold at the end of October and quit harvesting by March (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Changes in the abundance of seals were noticed after the *Exxon Valdez* oil spill. There are not as many seals around, some said, but “there were plenty before that,” and now, the subsistence hunters said, they look at the livers very closely. People have observed a lot of spotted livers and they will not eat spotted livers. One person said: “After the oil spill, we looked at the liver real closely; a lot of them were spotted. We haven’ gotten any from here this year. People are being careful…so damn much cancer around you have to be” (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Natives in the Kenai-Soldotna area have in the past had get-togethers once a month to eat things such as seal and beluga. It was estimated that 100 or so families in the Kenai area use seal or beluga. The number of families using seal and beluga has been growing as more families move down here from up north (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

A hunter in Kenai claims he is the last of the beluga hunters from Kenai itself. He told a story of coming back from the west side of Cook Inlet in his dory and seeing belugas in the mouth of the Kenai River. He had his wife with him. He decided to herd them up into the shallow water. After he did this, the whales were thrashing around so much with them in the dory in the middle, his wife got scared and then very angry with him for doing that and said she would never go beluga hunting with him again. He thought it was pretty funny. He remembers when Kenai celebrated “Beluga Days.” He would help harvest belugas for beluga hamburgers for the celebration; the beluga hamburgers were prepared at a restaurant in old town called Bookeys. This apparently ended years ago—in the early 1970’s (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

One Kenai woman said that her brother got a beluga and brought it into researchers because “something wasn’t right. When you’re eating then you wonder” (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

A hunter from Kenai said he has seen walruses going up the west side of Cook Inlet on occasion. Another hunter said a seal elephant washed up on shore just north of Wildwood about 20 years ago: “It was huge: made a sea lion look like a puppy” (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(2) Lower Kenai Peninsula

III.C.3.d(2)(a) Seldovia

Lillian Elvsaas, from Seldovia, stated that:

> We were brought up not to harvest marine mammals from March to the following fall. Hunters already know this. We have told the scientists that we already know when to gather our resources and when not to. But they keep asking us questions about what we want and don’t want. Those are the issues that people bring up, but the scientists don’t want to hear because they don’t practice it. If they could understand how we grew up—our spirituality—maybe we could resolve some of these things…. You also need to help ensure peoples’ subsistence rights. Any federally recognized tribe should be able to go out for subsistence any time (, Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000; UAA, Institute of Social and Economic Research [ISER], 2002).

Seldovia hunters hunt for seal in Tutka Bay, Jackalof Bay, McHune Flats, Illiamna Bay, and Chititna Bay, as well as Rocky Bay, Port Dick, Kachemak Bay, and Windy Bay (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Since one hunter began hunting (40 years ago, in the early 1950’s), he has seen a decrease in the seal population. He blames pelt hunting in the 1960’s for the decline but said the seal population is starting to take an upward swing. He also thinks that the *Exxon Valdez* oil spill probably got a lot of them. Other hunters say that in the last 7 or 8 years, they have noticed a decline in the seal population in the area. They have also run into skinny and sick seals, which they did not notice before. They also said that the feed for the seals is just not there. They have no idea where the feed has gone. Another hunter has noticed a notable decrease in the harbor seal population in the Seldovia area. He said that this decrease began about 10 years ago, before the *Exxon Valdez* oil spill. One of the local haulouts is Yukon Island, and about 10 years ago, he said, he would see 200-300 seals hauling out on this island. This past year he only saw 6 or 8 seals haul out there. He said the other haulouts were China Poot Bay, and Indian Island. He believes that all the haulouts have decreased populations but that the closest one (Yukon Island) has the most marked decrease. He has thought about the possibility that the seals may be moving to new haulout area, but he hasn't seen any. He thinks that there is a lack of feed for the seals in the area; there has been an increase in commercial, sport, and subsistence fishing over the last few years (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Another hunter stated that the old haulouts are barren:

> Before, you used to see 150 to 200 seals hauling out on Yukon Island; now you are lucky if you see one or two. China Poot Bay and Jackalof Bay are also barren now. On the ice in Tutka Bay, you used to see 200 or so seals, now you do not see nearly as many. It used to take him an hour to go out and get a seal. Now it may take him up to 2 or 3 days. (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999)

Hunters shoot seals in the water with guns, people said. They usually go out by themselves and slow the boat down before they shoot a seal. They prefer to shoot 3 year olds, because they do not have so many tendons in the fat. Hunters can tell a male from a female in the water by the head size. One hunter said he prefers to take males so he does not have to worry about taking a female with pups. Hunters prefer to get them in shallow water, because the seals did sink once in a while. They use a pipe pole to retrieve them (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

The favorite parts of the seal are the ribs and liver, one person said. The liver is prepared just like beef liver—fried with onions. Seal oil is rendered by putting the fat into jars and storing it in a cool place, but not too cool. They use the oil for dipping dried fish, kelp, bidarkis, and clams. They also use the oil to preserve meat in. They cook the meat, dunk it in the oil, and leave it in the freezer. Apparently, the oil helps preserve the meat longer in the freezer than if it were not dunked in the oil (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(2)(b) Port Graham

A Port Graham elder said that what drove him to become a hunter was his mother's need for fresh, wild food. She needed fresh bear, porcupine, seal, sea lion, bidarkis, and clams, and he got them for her. In the distant past, men normally hunted alone, and people only took what they needed; everything was shared (State of Alaska, Dept. of Fish and Game and Native Villages of Nanwalek and Port Graham, 2000).

Another resident said that a long time ago (1960's and 1970's), they used to hunt in October and November, and then again in February and March; also, during fishing season, when they were ready to come home from Port Dick (down below), they would bring home seal for the community. In the 1960's, they went anytime in the winter months. People like fresh seal any time. A long time ago (1960's and 1970's), they would go when people were low on food. In the 1980's, it is not done much (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

One hunter has hunted seal and sea lion most recently, the last few years, anywhere along the shoreline from Homer Spit to Elizabeth Island, but usually as far as Koyutolik (Dogfish) Bay. He has hunted at China Poot, Sadie Cove, and Tutka Bay most frequently. He has not gone to the east to the head of Kachemak Bay to the Fox River flats. He would like to go there for a few days to look around the area. He has always seen and heard about seals hauling out at Yukon Island. There used to be (5-10 years ago) lots of animals on the sandy beach on the southwest side—several hundred at a time. Now he does not see anywhere near as many. He has always heard about people going there to harvest seal, he has never been able to find seals there (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

One person said that sea lions have decreased on Flat Island, which has always been a haulout location. Sea lions used to be found east of Point Pogibshi, but one hunter said that he has not seen any there in a long time. There seems to be fewer animals around since he first started set netting in 1975. There used to be a lot of both species moving through the bay. Maybe the numbers of animals are going down because there are more people using them. Especially, there has been an increase of people from other communities. At Tutka Bay this year, he met a man who operated a charter boat and who had taken out a woman from Anchorage on a seal hunt. They went to the head of Kachemak Bay (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

There used to be lots of seals in Windy Bay close to the river mouth in Rocky Bay, one person said. "Especially in summer (when salmon were moving into the streams), there were lots of seal in Windy Bay. Hunters would stop on their way home from fishing down there to get seals to bring back home. Nuka Bay and Nuka Island, Delight and Desire Lakes area also had lots of seals." During the last few years, one hunter said he has not seen many seals in Windy and Rocky bays. During the halibut season in May and June, he has not seen any. He said that they went to Chugach Island beach 2 years ago, but there were no seals. He does not know about Elizabeth Island. There used to lots of seals on Yukon Island beach; however, today there are very few to be found. Last year they saw maybe 30 seals, whereas there used to be 200-300 at one time. "Now you often have to go to the heads of bays like Sadie and Tutka in order to get seals," he said (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

One hunter usually goes out in October and November. At the head of Port Graham Bay, the salmon wash out of the stream at that time, and the seals feed on them. He usually goes seal hunting while he is duck hunting. They used to take seals while duck hunting between here and Rocky Bay (there are several bays along the Lower Peninsula where they hunted ducks and seals). They also hunted while cod and halibut fishing near Gore Point (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

One person said that seal harvest is "simply [done] by shooting with a rifle, .22 magnum." He then uses a snagger (weighted treble hook) with a rod and reel to retrieve animals that sank (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Some hunters shoot seals with shotguns when they are on the rocks, so they will not lose them in the deep water. They would also hunt in shallow water so if they shot one it could be found and retrieved with a snagger. Starting in April, a shot seal sinks really fast, one person said. In the winter they float. Hunters used to try for seals on the rocks and sandy beaches. One time on Chugach Island, the seals were so thick they did not want to shoot, so they used the butts of their guns to club them. One hunter broke his gun. While running on the beach to catch the seals, he was out of breath. He noted later that his partners too were out of breath, but it was not because of running too hard. They thought it was due to all the oxygen being used up by the seals. After all the seals were in the water, a lot more were shot. When seals were on the rocks, hunters would always try to sneak up on them rather than shoot them in the water (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

One hunter said he usually goes with brother. Last year was unusual since his boat was being repaired, and he did not have it there. They sometimes ask other people who might like to go or who have not been out. He has not hunted with any elders, since all his passed away and he does not have anyone to teach him. When other elders were asked to teach him, they said it was not their place to do it since they were not related (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Size is not usually a deciding factor in the seals he takes, one hunter said. He takes whatever is available. With sea lions, people like the medium-sized ones, he said. "Big bulls are like a boar pig or any other big, old, tough animal. They are strong smelling, tough meat, and a huge thing to deal with" (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

A hunter said that he usually uses all parts of the seal except the esophagus, which is cut out and thrown away. He likes all parts of the animals. He usually makes sure the elders get the internal parts first. Those people know how to prepare the internal parts for food. They know how to braid gut, for example. Braided gut is stuffed with strips of meat and chunks of fat (to taste). The gut is braided around the strips of meat. Parts of the "innards" are also stuffed in. "The whole thing is then hung for 3 days, then smoked for 2 days, and again let hang for 2 more days after which it is boiled." Oil is made of the fat—heat renders his since he has not learned the other methods. He used the hide, whiskers (for decor). He is learning natural tanning methods, but does not yet have it down to working consistently. He would like to learn brain tanning (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

In recent years, he keeps a couple of meals of ribs and tenderloin, one hunter said. The liver and heart are his favorite parts and first choice. The fat is rendered for use with boiled humpy (pink salmon) and dry fish. They like to boil the fat to get out the oil. Fat is placed in a pan and heated on the top of the stove until the oil comes out (like bacon fat). Today, they feel they are using more seal oil since they found out it was low in cholesterol. They used to give away intestine to many people. Today, few people know how to use it, and there is not much demand for it. Lungs used to be given to older people. Pieces of fat, and meat and rice were stuffed inside. Some people smoked the stuffed lungs and would then bake it. Not much of this anymore. Kidneys too were once used by many people, but not much any more (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Hunters from Port Graham use to drop off seal and sea lion in English Bay when they were returning from fishing trips on the outer Kenai Peninsula. The Nanwalek people only had skiffs, and they could not haul much for a long distance. In addition, they did not have many skiffs. Today they get what they need for themselves, and there are not the quantities of animals there used to be (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

One hunter often delivers seal to households who his mom tells him should have some—he asks her who ought have some—she is also the chief. He also tells people (over the CB radio) to go to the beach and get some. With a limited amount, distribution is first to kin. Whatever is left over goes to anyone else, but this is usually left up to him. Usually the sharing groups are made up of kin and close friends. To him, sharing is the most important aspect of this (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

One younger hunter said that using these animals is part of the lifestyle. Subsistence gathering is what he has left of his ties to his culture. Since he does not speak Alutiiq, he currently has only subsistence. Some people do not eat seal or sea lion products during the Lenten holidays (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

A former Port Graham First Chief concluded, "Even if you're broke in the village of Port Graham, something's wrong if you go hungry because there's so much to live on" (Kizzia, 1995).

III.C.3.d(2)(c) Nanwalek

Elder Nick Tanape, Jr., said that bear hunted in the spring is best before they start eating fish. Spring bear is the best meat, and he prefers to make lard from it that he uses for cooking. Half a dozen hunters get bear in the village and they all give meat away to others. The best hunting is in Dogfish Bay or along the beach between Nanwalek and Seldovia. The bear head is always left and made to face east for better luck. Young hunters are taking up bear and seal hunting and he teaches (State of Alaska, Dept. of Fish and Game and Native Villages of Nanwalek and Port Graham, 2000).

Flat Island, "Qikertauwaq," which means island, is a traditional hunting place. It is also a haulout site especially for sea lions, but seals also used to be abundant there. Russian Point at English Bay also is a favorite spot for shooting from as animals swim past. Passage Island used to be a good place to hunt seals, but not any longer. Typically, and historically, seal and sea lion hunters went to Elizabeth Island (at some time of the year). Hunters still go there, but there are not as many animals around. Yukon Island also was a favorite spot (when there was an abundance of animals). Another hunter used to see seal all around the vicinity of the village. He also used to go to Elizabeth Island for seals, now there are few seals around there. Now he has to go up to Kachemak Bay (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

One hunter has not seen seal or sea lion in good numbers for a long time. He goes out fishing for cod and halibut regularly, and has been a commercial fisherman for years, so he has a good long-term perspective of the relative numbers of animals. In 1992, according to another Nanwalek hunter, you hardly saw any sea lions. This year they are passing by all the time. Seals just were not around much this past year although he did see some around Johnson Slough in March and April this year. He has tried for weeks to get a seal, but there has been nothing. He has even gone to Elizabeth Island and found nothing there (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Usually the shot animal is brought to the beach where it is either cut up and given out or, in the case of sea lions, people take what they want. It always disappears immediately. Everything goes. People come and get it and the amount they want, but they had better be quick, one person said. Seal are usually distributed by the hunters themselves so that everybody can (be assured) of getting some (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

The use of intestines is coming back after having been missing for some years. There are a number of older women who really know how to make braided seal gut, and they are teaching younger people (mostly women) how to do it. In school, they have even been using rope and rags to practice braiding. The liver of sea lion is not used much; one hunter feels it leaves him feeling hungry after awhile. Seals are used a lot during birthdays and name day celebrations (dinners). These meals are of the highest importance, and seals and sea lions are the first to be used. Usually looking at the sex of the animal is not important, however, some persons like eating the breasts of seals and sea lions and they like using the milk (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(3) Kodiak

III.C.3.d(3)(a) Akhiok

Testimony from residents of Akhiok included the following:

> This village came from across the bay. They moved here in 1910 from Alitak. They had a church there. At that time, these rocks were seal rookeries. That is why they made their place right here. They never thought they [the seals] would go away. Now the seals have been hunted out. We have to go up the bay now to Olga Bay. People at Alitak used to have enemies from the Chain. They called the Aleuts "Tayaut." They knew the Aleuts liked boiled fish and seal oil, so they trapped them by putting that food in the kayak. [Then, when the Aleuts were sated with food and drowsy, the Alutiiqs killed them.] (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> We hunt sea lions in Deadman Bay. There's a little rookery on the north side of the bay. Occasionally, there's a few stragglers there. And at Cape Alitak, there are a few sea lions. I haven't noticed any changes, but we don't see them very much. A few years ago, hunters got one or two from there (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Harbor seals are going up in Olga Bay. In Purgatory Bay, there's a couple of seal rocks we usually go to. There's always 20 to 30 on that rock and more on Upper Station. There's more there now. It must have been July. I haven't noticed where they're down. In spring and fall, check it out—that's when they move onto that rock. That's the hunting seals (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> If you can, in a rookery, don't spook them. You have to go according to the wind and be quiet. They can smell you. Get up to them. In a boat, if you hunt in open water, they're very suspicious animals. If you're very quiet, they come closer, and then bang! (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> For seal hunting, we'll take a couple skiffs, to help each other out when we're loading it up. We get seal from a boat, or if they're on the rocks we sneak up on them. It's not easy. You gotta be patient. I go for a medium size. You can't tell if they're male or female. Sometimes they sink, and you have to get to them right away (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> In winter, people would go to Fox Island in front of our village. Seals don't haul out there anymore. Seals are scarce around here. The closest is 15 miles away, at the head of Olga Bay. The biggest culprit is the state allowing set netters to set off those reefs. They're taking away subsistence (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> We butcher them right there. Bring them home and cut them up, and give it to whoever wants. We use the whole works. If I got a seal, I'd take what I wanted and call on the radio for everybody to get some. For myself, I'd take the ribs and meat. Also we eat the liver and heart, and flippers. We eat braided seal guts. With sea oil, put it [the blubber] in a jar and the oil just comes out by itself (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> When hunting sea lions with two skiffs, they alternate herding them back and forth until they're tired out and can be approached easily. It takes a lot of gas to do this. Another way to tire them out is to watch for them to surface and shoot your rifle to make them dive again before they can get a full breath of air. You can waste a lot of shells doing this (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

One hunter prefers to go for a medium sea lion, 10 feet long. “Those big ones are too big. There’s no difference in taste. Sometimes we’ll go for a big one and divide it with everybody. But you have to load it in the skiff. A big one takes too long to get back home. First you tie it to the side of the skiff, then drag it to the beach. We’ll have four guys in a skiff” (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

> The difference between sea lion and seal: seal is darker meat, it’s got the real wild taste. Sea lion flippers are a delicacy. Just boil them. They’re called weenum itschka. They’re kind of fatty and gristly, like pig’s feet. Sea lions sure do have a lot of meat. You may have noticed that Natives like fat. They eat it raw, or let it ferment. Put it in a poke, cut up all the fat, put it in the sun. Boy, that stinks (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

> Fried [sea mammal] fat—Russians call it oosorkies. Slice it thin and fry it like bacon. Ordinarily the Natives would just eat the raw oil with fish. Seal liver is very rich in iron. We love it fried with onions. Alishuq is seal head, boiled. We eat seal flippers like sea lion flippers, boiled. The intestine is kaluyuq. Clean it, it’s a few miles long. Clean it real good in salt water. Then the work comes. Then take three-foot-long (or cut 10 inches long) strips of seal fat. Braid it with the seal intestine like a boat fender. The women know how to do it. Their hands go sixty miles an hour. Then boil it. I miss it so much. You can eat it cold, cut it into sandwiches (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

> In the old days they used to share seal with the whole community. Cook stew in a big black kettle in a barabara. Give us kids each a little container to get some and bring it back. Sometimes we would “miscarry” it and have to get some more. One seal for my family is quite a bit. We give quite a bit away. When a sea lion is landed in the village, a call goes out on the CB and people flock to the beach and help themselves. Everyone who wants some gets some (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Some feel that people in Akhiok are eating less and less seal and sea lion all the time. One hunter and his wife still like to have “something wild” now and then, but their kids will not touch it.

> I can’t say about sea lions. If you go through everybody in Akhiok, they haven’t got any sea lions. They have gotten a few seals. We used to depend on sea lion but people hardly use them any more for eating. Just to do something, they go. We don’t really depend on seal, just Safeway stuff. It does get eaten (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(3)(b) Karluk

Residents from Karluk said the following:

> With bear, there was a law for subsistence use. We lose one tradition after another. It’s hindered my own hunting of it. It will make a roundabout...I wouldn’t make it a habit to get because we’re nervous that something might not be right (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

> We get sea lions anywhere, but we don’t normally like to play around with rookeries. You don’t mess with charging bulls. Sea lions will sink off a rookery. I like to get them off a beach. The old people knew ways to get them. I haven’t now, for the last three years (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

> Usually two hunters go together [for sea mammal hunting]. If the other party didn’t get any, give him some. The men do all the gutting and cutting. The hunting is about the same now as it used to be. Winter is the main season. We don’t eat sea mammals in summer because there’s a lot of fish. There’s no interest in summer (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

> You can hunt sea lions in Nordean Harbor, Cape Uyak, one half mile below Sturgeon River. The same two bunches disappear for a while and come back. I notice them in different places. I’ve seen them all over the place. Seal hunting takes place right outside Karluk, at Sturgeon River, and Halibut Bay—mainly out of Sturgeon, Larsen Bay, the rookeries out at Seven Mile. They don’t

seem to dwindle. We go after them once in a while (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

The younger generation goes to the store. When all the older people were here, they'd get one sea lion a month in winter. But no sea lions have been caught here in the last two or three winters. There's not much interest. For the whole community, 8 to 12 seals are taken during the winter (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

The number of sea lions taken in this community used to be five or six. It used to be 20 or 30 seal. Now the numbers are down. The numbers have changed. We'll be afraid to hunt sea mammals until we see it on paper that it's legal. I'm nervous now about the seals. They keep putting protective coating on the animals, but what's happening to us [Natives]. They have got to realize that they are forcing us to live the white man's way of life. Forcing us to move to places we don't want to move. Sea otters used to be eaten. The Natives quit because of the laws way back when (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

You butcher them as soon as you get them. We take virtually the whole thing—all except probably for the hide. No one does anything with the hide. We used to use the whiskers for masquerades, for masks and stuff. We quit doing that 15 or 20 years ago. On holidays, seal is important food—both for Russian holidays and the ones that are red on the calendar…. There is an extensive trade system between Larsen Bay and Karluk (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

I never pay attention to management. We just take what we need. We don't hardly touch sea lions. We do hunt seal. I get maybe 5 seals a year. About 20 harbor seals are taken for the whole community for a year (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

I like seal over sea lions. Sea lion meat is a little stronger. For sea lion, I would take a medium size one. Otherwise, the meat is too tough. I prefer the medium ones. A big bull can weigh 500-1500 pounds. On a sea lion, we eat the shoulders and hindquarters. The ribs are all right. They have a good-size liver. Some bake it. Sea lion liver is milder than seal (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Probably in winter, their fat is the best then. In summer, something in the fat changes. It's richer in the winter, like corned beef fat. I rank seal #1, sea lion #2, deer #3, and beef #4. That on just the taste, not the richness (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Seal fat gets real soft. Slice the fat and fry it, put it in a jar. Eat it with dried fish. Fry up the seal liver. Make boiled seal ribs, seal soup. You have to soak seal to get the blood out. Nobody does anything with the other organs. I like the whole thing. For flipper, keep the skin on (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

We'll never get away from seal. We need it. Young people are learning how to cut them up. Everybody goes down and watches them cut them up. Hunters cut them up. Or, if the hunter didn't cut them up, get someone experienced. Women do the braiding and cooking (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

It used to be you couldn't bring the sea lion skull or hide back. It couldn't be stepped on or abused by women. Bear hates sea lion. When you hunt, go for a "walk" or a "ride." Never talk about it. Cleaning the sea mammal parts was disregarded. Anything you didn't use had to be left. Don't take back the hides unless you use them. The bear hide was always left. We used sea lion hide for bidarkis and stuff like that. It was bad luck if you didn't treat it properly. You have to dispose in the proper way (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(3)(c) Larsen Bay

Larsen Bay residents said the following:

Last time I got a seal was last fall [a year ago]. We get them in late September to March or April. They have pups in the spring. I get them from a skiff or sitting on a rock. Go to Alf Island, beneath Amook—there are thousands of seals. I hunt where they congregate: Larson Lagoon,

> Ditto Islands. They used to sit by the setnet site at Pollock Point. Don't see many now. There are less and less because the salmon run is pretty low (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> There's seal around, but not so many as sea lions. Seals haul out in Uyak and Amook. There's as plentiful as they always were. But there's never any sea lions around here. Usually sea lions are around. Chief Point used to be the sea lion place. They're in and out of here constantly. Seals are all over, in any of these bays. Right here in the channel (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> The whole village of Larsen Bay gets 3 to 5 seals a year, and 1 or 2 sea lions. Sea lions are hunted from "right now" till December or January. You can get seals any time of the year. We hold off in their birthing period, and we get more seals in winter time (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> You never go hunting alone. Gut it [seal] out there and save the guts. Take the whole darn thing—intestines and all, save the fat. Take the intestines for sure (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).
>
> One hunter doesn't even hunt deer anymore. He checked with NMFS at Gibson Cove and found out it is OK to shoot sea lions for subsistence (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Seal liver is better than deer. It's more nutritious, has high iron content. We eat every part of the seals, including the intestines. I never braided a sea lion intestine. Braid seal intestine with meat and fat together. Soak the intestines out and clean them, cut notches all over and keep cleaning it. Seal liver is like beef liver. You have to soak it out. I don't care for the lungs and heart. One hunter fills the lungs with fat and bakes them. I eat it but I don't make it. I don't eat the brain. I've eaten deer tongues, every part of the deer (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> I don't know which I like better. To me, they're both the same. Sea lion has a better liver, it's sweeter. The liver is almost as big as a table. There's enough liver for everybody in the village. You get the back strap and round steak [for any game animals]. Sea lion has more meat and has great big flippers which make great pickled flipper. Seal blubber is better. You render it and let it ferment. The oil all comes up in the bottle. Cover the bottle. It's good for boiled fish, tastes like walnuts. Keep it in a cool place, like the refrigerator. You couldn't do that with sea lion blubber (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> They used to hunt reindeer and dry it. Thirty years ago, the reindeer used to come right in the village. Deer is something that supplements your diet, like other land animals. Seal and sea lion, that's part of your diet. Then you go out and get ducks, ptarmigan, deer, whatever. It's the same as seal hides—long ago they used to use them. They are waterproof. They used to use the whiskers for needles for sewing, even sewing broken bodies (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(3)(d) Old Harbor

Old Harbor residents said the following:

> There used to be many sea lions at Cape Alitak but no more. Old timers say it's because hunters have let their guns touch the rocks, and sea lions don't like the smell left by iron and steel. Also, between Red River and Halibut Bay there used to be a lot of sea lions (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> We slaughtered a lot of seals around here in the late 1960's after the tidal wave because David Green (Anchorage furrier) would buy the skins from us and also because there was a bounty on the noses. You could get $3 for each seal nose, and David Green was paying as much as $60 for a good clean seal hide. We would brine them real good and then roll them up, and that would keep them soft. Once I sent in 100 noses but never heard anything back, so the next year I decided to dry them. I dried about 100 noses. But I finally got tired of waiting and threw them all away, and

then the week after that I heard they were paying $3 apiece for them. I just threw away $300 right there! We're partly to blame for the shortage of seals now because we'd go out and shoot 70 or 80 of them at a time (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Hunting areas for seal are at Fox Lagoon or McDonald Lagoon. Generally, they're bay hunting now. Other areas are Three Saints Bay, Puffin Island, Barling Bay, Big Creek, Three Sisters, on the rocks at Natalia Bay. The seals are coming back at Natalia Bay. Formerly, Natalia had up to 100 seals inside the lagoon, but we haven't seen any for several years. I haven't seen any at Puffin Island (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

I hunt seal from a skiff or from the beach. If you see the seal, stop the skiff. Shoot the seal from within 20 yards or so. Get as close as you can. If they sink, try to be there quickly. Some hunters use a pole with halibut hooks [to retrieve them] (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

For sea lions, you get them as close to the beach as possible. They have rocks in their stomachs, so they sink even more. I think it's an Aleut story: they spit on you and put a hole in your skull. They get fat in the winter and use rocks for ballast. Or they use the rocks to grind bones up. I'm seeing more harbor seals and sea lions this past year than I have for a long time. Last year I got the biggest seal that I've ever seen, even though I am not selective about which ones I shoot (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

The old Aleut way of hunting sea lions was with 3-holed kayaks. The front and back holes would be occupied by paddlers, while the middle slot was reserved for the shooter. The paddlers would pull up alongside the rocks where the sea lions were resting and jump out. This had to be done very carefully or the barnacles would just tear up the kayak. The hunter would then shoot the sea lion, cut open its throat, blow air into its lungs, and then tie the throat shut with a piece of line. Then he would roll it over into the water and wait for the kayak to come back in to get him. When it pulled back up to the rocks, he would hop in, and they would tow the sea lion to a beach where it could be gutted out and cut into small pieces (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Brown bear intestines are 30 feet long and 4 or 5 inches wide when they're dried and split. These are what they used to use to make waterproof parkas, which they tied over the kayak holes to keep the inside of the kayak waterproof (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

It used to be that harbor seals were taken by clubbing, especially on Puffin Island. This was especially true when there was a bounty on them. This harvest method is no longer used, however, and one hunter claims it is not traditional (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

My father always said, "Don't shoot the dolphins. They will lead you to shore through a fog" (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Hunting patterns have changed in recent years. It used to be that you had to go way out to Cape Barnabus or Two-headed Island in a big boat to get sea lions, but now they're swimming right through the channel in front of Old Harbor, and you can get them with a skiff. It used to be also that sea lions were taken 15-20 at a time and brought back to feed the whole village, but now only one or two are taken at a time. About 3 weeks ago one hunter saw about 150 sea lions at Cape Barnabus, which is a lot more than he saw there last year (1989) (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

When we entered the house the family had just finished eating dinner, and the hunter could smell the seal oil and says "seal oil is just as good as steak sauce on steaks" (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(3)(e) Ouzinkie

Ouzinkie residents said the following:

> We used to eat all kinds [of sea mammals]. Not anymore, they shut them off too much. We used to eat dried fish, nothing but wild food. Sometimes we didn't even have bread (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Sea lion hunting is a big pursuit here. Seal and sea lion both. I get about one sea lion a year myself. Maybe there are six a year for the whole community. Seals are not as big so they're easier to put away. I get one seal myself, the whole community might get twelve (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> I haven't noticed changes in populations of sea lions. Seals have always been declining since the days when they had a bounty on them. They compete with sea otters for the same foods. We are getting more sea otters in this area. I haven't noticed any new places where seals congregate. There used to be a lot of seals before (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> There used to be hundreds of seals at Monk's Lagoon, Litnik, and Salmon Creek. Now you'll just see one or two. There have been no seals around here for quite a few years, maybe five or six. I used to hunt anyplace, all over. They disappeared. I saw three seals all summer. I saw a few in Uganik Passage (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> There's hardly any seals—saw two in Tonki, a couple in Big Tonki. There was one in McDonald Lagoon, he took off. I used to hunt them in Afognak, Danger Bay, Little Afognak, Noisy Island. There's no more around there. They're pretty scarce. Last year I got two the whole year. I got them "across here" [Kodiak Island side of Ouzinkie Narrows]. Last year there were 40 or 50 on the ice at Anton's when it was frozen (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Back in the 1960's, they stopped the bounty on seal pelts. A few did it for a living (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> On sea lions, use everything all the way to the flippers. Boil it like pig's feet. We'll eat some of the fat. Freeze the meat, or salt it. I have never used sea lion hides. Maybe somebody has. It's a little harder than a seal. I quarter sea lion in the field or roll it in the skiff. I hunt in the whole of Marmot Bay (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(3)(f) Port Lions

Port Lions residents said the following:

> That's all they lived on before—seals, bears, beaver, ducks, sea lions.... Sea lions not around here too much, I never did try it. A few people in Ouzinkie hunt sea lions. I never tried beaver neither (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> I like deer and seal. I tried bear a few times, don't particularly care for it. The younger generation is spoiled. Some don't even care for fish. Me, I'm not choosy (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> They used to use seal oil for oil lamps-for lamps, not for heat (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> The younger generation doesn't like to live off the land. Before the majority of people lived on subsistence. They would just buy some sugar or tea (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> In the 1950's there were hundreds of seals and sea lions. I grew up in Ouzinkie. Seal used to haul out in the Triplets, Steep Cape, and Raspberry. Marmot [Island], I never went out there. Nobody goes out there. Nobody harvested sea lion, it was always seal. In the 1970's things changed. People were hunting more deer and elk (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

> They're in the head of Kizhuyak, Anton Larsen all year round. They'll lay on the ice in winter. They have pups in spring at the heads of the bays on the rock. There's some on the island, too—ten to twenty. Some will lie on the rocks by the island. Glamm Island, a couple of years ago you didn't see any there. Seals are up the straits in Kupreanof, at the head of the bay. They were all over before, till the late 60's. There were so many. Now, they seem just as plentiful. They're showing more. I've seen 30 in Whale Pass (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> We hunt seals from October or November to January. They float in the winter months. They sink when they get skinny. You only shoot them when they're going to float. In spring they have babies anyway. Most of the people here hunted them in winter. My brother in Ouzinkie will do the same. He does it a lot more while he's duck hunting (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Subsistence seal hunting: We'd like to have that right remain—we still get one occasionally. About 25 seals a year get taken in this community (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Since the 1970's and 1980's, seals have gotten real scarce. In the last couple of years, they've gotten more and more [increased] (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> There's seal hunting all year. The major time is winter. You have to shoot them when they're facing away from you. Otherwise they sink, or its face will fall in the water. In springtime they sink. In winter they have a higher fat content (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Boil the seal meat in soup. Or it's good roasted. I don't make oil, my dad used to. Cut the fat in strips, not all the way though. Stick it in a jar. The oil comes out on its own, but it stinks (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> To prepare codfish stomachs, take the liver and stick it in the stomach. That was the same way they did the seal - braid it and cook it. [An elderly man apparently no longer around] used to make braided seal guts (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Ribs and briskets of seal are the best for soup or boiling. For the shoulder it would be roasts. The back strap is good. I leave the fat behind. Liver and heart, use that with your soup, or use it for gravy. Or fried. Non-Natives ask for seal liver (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Seal is not a traditional holiday food. Salmon perok and duck soup are. On Russian Christmas, January 7, we used to have those little crested guillemots [auklets?]. That was what my dad used to get (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(3)(g) City of Kodiak

Talking about subsistence, Julie Knagin, from Kodiak said:

> The bottom line is that I see that nothing goes to waste. When the Natives catch anything—whether it's fish, marine mammal—nothing goes to waste. Everything is used. It's nothing like all those trophies you see in airports all over. What happened to the carcasses of those? They were all thrown away. That's our life style. It's our survival. We never depended on Safeway. We never could. It was never there. We got the basics—coffee, tea, sugar—but everything else was from land and sea and air (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000; UAA, ISER, 2002).

III.C.3.d(4) Southern Alaska Peninsula

III.C.3.d(4)(a) Chignik Bay

Chignik Bay residents said the following:

> Sea lion rookeries are Agrapina, Kilokak Rocks, and Mitrofania Island (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> The sea lion population is increasing in the area but seals are way down. Sea lions chase away the seals. Years ago there were more sea lions at the capes, but now with so many boats, they move somewhere else. They return in the fall months after fishing. They move out to further rookeries. They aren't declining but just going to other places (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Will get a seal if running to do something else and see one. Don't go out specifically to hunt a seal. Costs too much in fuel. Used to go out in Dories and get bunches of them when younger, but now, not many people get them or use them, and are hard to find (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Sea lions and seals eat any kind of fish. When a storm is coming, sea lions swallow a large rock so they can ride the sea better and dive. Have noticed a lot of really big sea lions lately. Take sea lion meat, grind it up, eat like hamburger (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Pollock and cod tend to migrate in the ocean in large circular paths. Moving from one area to another and eventually come back. They might be flowing with the ocean currents (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Usually spend winters in Kodiak. There are a lot of seals and sea lions there. See more there than here. Between here (Chignik) and Sand Point hardly see any sea lions. Saw a lot sea lions here in the Bay chasing in herring (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Seals are really down, hardly any of them (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> A long time ago we used to hunt seals for bounty. We first had to send in the noses, then in the 1950's and 1960's, sent in the hides. Was just a kid when had a Chesapeake dog that would swim to retrieve the seals. We would skin the seals, salt them and send them to Juneau along with sea otters and get $100.00 a pelt (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> One hunter usually harvests one harbor seal every year. Likes the ribs and liver and gives the rest to whoever wants it. Ugashik area has a strong population of harbor seals. Seals are down in Chignik area. They might be just moving to other areas but only see 2-3 of them a day. They eat pogies. When get seals, put the fat into 12 mason jars and send it to relatives yearly (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Don't know anyone here that eats sea lion. The animals are disappearing more and more. This includes birds. Think that the birds that fly south are eating lead pellets. While fishing up here in Chignik all of life (20 years), sea lions don't see to be going down in numbers, but usually just fish the Lagoon, not the capes. The draggers are really bad. They get all of this by-catch. They have so much political pull and the sea lions and everything else pays the price because these people support our politicians, and money dictates the management, not biology. Haul-outs are between Sutwik Island and Kilokak Rocks. Not sure where they have their young (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Haven't seen many ducks in the area. The little butterballs haven't seen many all winter. When growing up, we spent the winter months on ocean beach trapping. Would live off of birds, ducks, ptarmigan, sea lion, seal, porcupine, etc. (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

> Don't see the harbor seals like we used to. Feel sea lions are changing their habitat. Old rookeries are vacant and new ones being formed. Where fish can be found is where seals and sea lions put their rookeries. They follow the fish. If an area gets wiped out of food then they move to a new place (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(4)(b) Chignik Lagoon

Chignik Lagoon residents said the following:

> The best places to hunt seals are on the sand bars. When the tide goes out and they are on dry land (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> For seals, drive up to where they are at, turn off boat motor, and whistle at them. The last one hunted took 3 days to get. More are present in the area in the summer when the salmon are passing through the Lagoon, but hunt in the winter because have more time. Fish in the summer. After hunt them, cut up and freeze or salt the meat. Render the fat by putting into jars and renders on its own. Parents like the fat frozen, then they boil some of it with the seal meat (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> In the mid-1970's, some locals hunted seals to sell the skins. We would salt them and send them to town. Would take 200-300 of them, in Prince William Sound and some in the Chignik area. It was legal to do this then. A local person worked on a big boat that traveled around to hunt them. He got $100.00 a piece. They hunted with rifles, and preferred the pups because the hide was softer and in better condition (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Don't see sea lions anymore. See more seals this year, however, haven't seen that many since the oil spill. Has been 30 years since seals and sea lions were strong (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> The sea lions and sea otter started to go when crab and drag fishing started in the area. They even used sea gulls for bait. This is still happening all over. The draggers and high seas drift gets everything in their path (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> In 1987 before the spill, we had a winter like this year, nice weather in Jan.-March, cold in April. I went out looking around in April and saw thousands of dead baby seals out in Chignik Bay, in the shallow waters near Anguvik Island. They must have been in other areas too, but is the only place I looked.
>
> The seals were about a foot long, must have been aborted. They were visible around the island in 15-20 feet of water. The population of sea lions was going down prior to the oil spill. It was before the spill hit Chignik that I saw the aborted harbor seals. The seals are gone. The Island we call "loaf island" used to be a major seal area, but no more (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> I have seen pups on what people call haulouts. The whole peninsula (Alaska) from Kilokak Rocks to Cape Igvak isn't like it used to be. There used to be 100's-1,000's of sea lions—the area was crawling. 5 years ago, all we counted was 6 in the whole area. The rookery at Puale Bay was wiped out in the 1970's (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> At Cherikoff, for example, and other areas where draggers aren't allowed, sea lions appear to be coming back (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Have noticed an increase of fur seals in here. Caught 3 last summer. Noticed more and more over the years an increase. Catch them out in the Capes. See them in Chignik Bay too. We just let them go. Seals and sea lions are on way out in the Chignik area (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Walrus came into the area 5-6 years ago. Possibly passing through, or lost (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(4)(c) Chignik Lake

Chignik Lake residents said the following:

> Mitrofania and Chiachi Island have a lot of seals and sea lions that haul out and maybe pup there. People fish right next to these islands, and a large amount of sea lion movement occurs here (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Went out in boat to Nakchamik Island with whole family in summertime around August. Had 2 skiffs. Dad was with us to show us where he used to hunt seals. We drove them up near the shoreline, shot two, and quickly went up to them before they sank. Retrieved them with gaff, fish lure, or jig hook (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> I hunt them (seals) at the mouth of Chignik Lagoon. I go alone usually; and use a hook to pull them into the boat. I try to take smaller ones and can pull them right over the stern. They are easy to get (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Occasionally, a seal will walk up on the ice of Chignik Lake and we can get them there. Hard to tell the size of a seal when it is in the water. They usually hang out in packs. Easier to get when tide is out. Better chance to retrieve them. We hardly ever hunt in deep ocean waters, just close to shore. We don't hunt in deeper ocean waters because we would lose the animal (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Two seals were killed this winter on the ice of Chignik Lake. Sometimes seals will travel the lakes and walk overland to the Bristol Bay side. Don't know why they do this but we have seen them do it (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> I made a spear to retrieve seals. I learned how to make the spear from Eskimos, where I grew up. It is constructed of wood, and I use a brass tip. The points were once made of ivory, but brass works fine. After I shoot the seal then I spear them and hang onto the attached line and pull them into the boat, or onto the beach. I usually don't go out specifically to get a seal, because seals know, and I won't have any luck. I have to be doing something else, then I will see a seal and usually get it. Whenever I go in my boat, I am always prepared (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Before the [*Exxon Valdez*] oil spill [in 1989], I used to see a lot of seals and used to see them on the beach (by Chignik Lake village). There used to be more ducks too, but has been way down. I received less ducks from hunters this year than in the past (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Sea lions are mostly getting killed off by the draggers. I have never set foot on a dragger, but have watched them and see how sea lions follow them and get caught in the nets. Ever since draggers have come into the Chignik Area, have noticed a drastic drop in their population. This winter, there were quite a few over in Chignik Bay feeding on the waste products from the canneries processing cod (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> We jar up the sea lion and seal fat and send it away to Perryville. We keep a lot of it for us. Love stink oil. Can use it to dip dried salmon or wild celery into. Can bake clams with the oil (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> We boil up seal like pot roast with vegetables. It tastes good. Like to cut it, boil it, or make pot roast. We braid the gut, boil it with seal grease inside. The grease cushions it (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(4)(d) Ivanof Bay

Ivanof Bay residents said the following:

> We hunt for seals in teams. Go out looking for seals, birds, caribou. There is a gunner and a skiff driver. Hunt mostly in the bay (Ivanof). Use hook to retrieve them if sinking. Doesn't matter if we get a small or a large seal. The older ones have more meat, but they are also tougher eating (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

One year, the candlefish were real dense at first creek and Big Creek, Ivanof Bay Village, first creek east is first creek, second is Big creek. First creek west is Waska Creek, and second creek west is Smoky Hollow. We get salmon in all of these, but mostly Waska creek. Seals hang around the mouths of these creeks when the salmon are going up the rivers. We usually hunt them here (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

We hunt for seals out of a skiff. Try to get in rocks then in shallow. They are getting smart now. Got in Ivanof Bay. As soon as you shoot them, run right up to them. Usually have enough air in them after coming up for breath of air, and they float (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Usually get seals off of beach. I will get out and walk off rookery and shoot them. They are in the rookery and roll off into the water. Then I get in my skiff and go get them. No preference for season—probably late fall. Never get in summer to spring. I'm busy in the summer. I work maintenance and travel a lot. I use a 22 and a shotgun—#2 shot, close range. We have a jig in the skiff. Hook handy if they are close enough, don't have to worry about sinking (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Last 2 years notice more seals than before in Ivanof Bay. There was a great decline of them over last 10 years or so. Recently saw 5-6 seals around Road Island and at the mouths (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Only place [we] see sea lions are on outer islands. Used to be a lot on Seal Capes 20 years ago, now, just a few see only a few following candlefish in or salmon. Seals [there] are a few of them, but not as much as there used to be. Don't really have an opinion on declining. Perhaps a lack of food or pollution. The main thing that they feed on, salmon, octopus, and cod fish. Has something to do with the oil spill. Still finding oil outside of the bays. Brother saw oil recently at Humpback Bay. We have been noticing black helldivers that have washed up dead on the beach. Castle Cape and Seal Cape ran into oil sheen 7 miles off shore last summer (1992). In a few places as far as could see, ran for a hour and half and it smelled like diesel. Probably came from some boat that might was dumping it. This was a lot of oil, maybe 400-500 gallons. Spread really wide (September, 1992) (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

We take everything out of the seal. Leave the seal hide, because it is too hard to process the hide for tanning. The flippers of the seal are a delicacy, but usually send this to relatives in Kodiak "starving Natives in the city." We keep the intestines. If they look OK. Wife cooks braided seal gut. Stuff it with fat, cut sides of gut into holes. Squeeze and pull out insides of gut first. We cut 4 long strips of gut and put the seal fat in the center of it and braid it. Braid it like macramé. Boil it with salt. Serve it with home made hot mustard. Seal meat is important to us because it contains a good source of vitamins (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

We got three seals last year. Took 1 to Perryville and had all we needed. If people are out of oil, we don't go in summer, too busy fishing. There are fewer and fewer seals in the area. Husband guts and cuts into whatever we need. Calls on the radio or phone asking others to cut off pieces they need. I freeze the meat, to give away to parents or others wanting the seal meat. Whenever we catch a seal, we share it with each other. Fresh seal meat, we soak it in water to get the blood out of the seal. Don't soak it in water for too long, because it loses its flavor. Sends it to Perryville, Chignik and Anchorage. We keep the guts, clean them, stuff them with fat and braid them, boil them and eat. If we don't someone else in the village will, unless it is in bad condition or looks diseased. We take the liver too, but [it] is all we use of the innards (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Have heard that some people use seal oil for a lubricant for hinges/bolts/screws etc. We always take a steam bath after camping, picnicking, or hunting. No real reason other than just dirty and cold. We don't have any rituals about bear hunting. Dad likes the meat and uses it in stew. I like the fat. Hunt bears just around here. We get it every fall. Don't go every year. We shoot problem bears though (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

III.C.3.d(4)(e) Perryville

Perryville residents said the following:

> Last winter when I was collecting sea urchins I saw a big ball of eggs. It was sculpin. I saw grey whales today [May 20]. They came along the shore. They must be looking for fish. We smoke candlefish (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Before we went to Spitz Island, a flat rock, we would hunt sea lion and seals in dories in the 50's. There would 3 or 4 in a group. The Rookery—we don't find many out here now. The beach on the north side of Spitz Island is a haulout for seals. In the old days we used to camp at Mitrofania Island. Now we get 1 or 2 sea lions here a year. Can't get enough seals here. The northeast end of Kupreanof Point is another sea lion haulout. They have their young here. We don't usually shoot unless the wind is right to come ashore (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> I spent the first six years of my life in Perryville. As a child (circa 1920's), we used to eat a lot of seal and sea lion. They were plentiful (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Will hunt seals once in a while when they pass by on the beach. After shooting them, we will retrieve them with a hook of fishing pole. They will float for a few minutes then sink. We bring them back to the beach and give some away, so it is shared (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Got one seal from the beach and one from the boat or out at Islands is where we go. When we hunt seal we are out exploring and get them if we get them. If I go hunting along the beach, I take my fishing rod to retrieve them. We use heavyweights. Sea lions—we hunt from the beach. We try to get them when we are close enough. Otherwise, they sink. Then we drag them back and butcher them at home. People come and take what they want (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Seals have gone down a lot. It has more than 10 years, maybe longer, since we have noticed a lot of seals. Sea lions—once in a great while—we will see one go by. When the candlefish go there are some but, I don't know what is causing them to decline. I have only seen six in the last year. In Bristol Bay I see factory trawlers. I watch them picking up waste products. Have noticed them right in the stern while dragging, when they are pulling the net in. I will hunt with another person. Use a jig too (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> The sea lion are starving. Very little gets back to the bay. In 1963 we fished Aniakchak and another place out by Alexander Point. Has been built up since the 70's. Gunard Andersen was the first to fish here. The king crab fishery is depleted. Even the streams are starving for fish. The hooligans aren't bothered (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> When we go picnicking in summer we will almost always take sea lion or seal or other Native food with us. When we go out picnicking we will break open moose or caribou bones and take out the marrow. It's good with fresh bread and soup. It's like tallow. Fry it with boiled fish. Good. Delicious (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).
>
> Seal guts—they boil it with fat. Cut the fat in strips then braid the fat around strips of gut. Caribou—keep the fat, meat, marrow and different parts including the tongue. It's different in Old Harbor. I learned how to split moose and caribou from my mother-in-law after I came here. Ptarmigan—tear the skin off of them. In Akhiok after the tidal wave, we plucked them (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

See Section III.C.7 - Environmental Justice, and subsections IV.B.1.p(7) - In-Place Mitigation and Ongoing Mitigation Initiatives and IV.B.1.p(8) - Mitigation Initiatives Related to Sociocultural Impacts for a discussion of the use of Regional Traditional Knowledge in the lease sale planning and decision-making processes.

III.C.3.e. Community Subsistence-Harvest Patterns

III.C.3.e(1) Upper Cook Inlet

Tyonek, on the west side of Cook Inlet, had a subsistence harvest area that extends from the Susitna River south to Tuxedni Bay; subsistence harvests concentrate in areas west and south of Tyonek (see Figures III.C-18 and III.C-19). Moose and salmon are the most important subsistence resources, although important components of the harvest include nonsalmon fish such as smelt, waterfowl, clams, and a traditionally important beluga whale hunt. The annual round of harvests by Tyonek residents is depicted in Figure III.C-9 (State of Alaska, Dept. of Natural Resources, 1999).

The subsistence harvest of salmon is provided through a set gillnet fishery. The Tyonek annual subsistence harvest for salmon from 1990-1997 (most recent harvest data) can be seen in Table III.C-5 and Figure III.C-27. Because of their early arrival and large size, chinook (king) salmon are an important part of the subsistence harvest. Coho salmon are harvested for subsistence and commercial sale; sockeye, pink, and chum salmon harvests are important primarily for commercial sale. Salmon makes the largest contribution by weight to mean household harvest. Chinook salmon are cut into steaks, fillets, and strips for smoking; a variety of traditional products are made from the head, tail, fins, backbone, roe and milt sacks, heart, and stomach. The entire fish is used, and no portion is wasted (State of Alaska, Dept. of Natural Resources, 1999).

Salmon fishing begins in the spring, and coho fishing continues into September. Dolly Varden and rainbow trout are caught using rod and reel in local freshwater streams throughout the summer. September begins the harvest season for moose. Moose hunting is done locally off a local network of logging roads and by boat in regional river drainages. A prime location is Trading Bay. Fishing and gathering activities are normally combined with the moose hunt. After salmon, moose make the second-highest contribution by weight to the annual household subsistence harvest. Waterfowl are hunted at the mouths of Nikolai Creek, Middle River, and McArthur River. Harbor seals are hunted opportunistically along the shorelines of Trading and Redoubt bays (State of Alaska, Dept. of Natural Resources, 1999).

During the summer, villagers organize hunting trips for beluga whales, which are hunted in stream mouths. Hunting takes place in upper Cook Inlet from Anchorage to the Beluga River, at important locations that include the mouths of the Susitna, Theodore, and Beluga rivers. Most hunting occurs between mid-April and mid-October. In the last several years, the hunt has concentrated at the mouth of the Susitna River and toward Knik. Hunters use open-top dories and harpoons and buoys that minimize the loss of a struck whale. Weather is a major factor in hunting success, and Cook Inlet’s shallow waters are notoriously dangerous. Beluga meat is eaten fresh after roasting or boiling and is also preserved by freezing. Beluga blubber is rendered into oil and refrigerated for use in cooking (Stanek, 1994; State of Alaska, Dept. of Natural Resources, 1999).

Federal marine mammal regulations have allowed Alaska Natives to continue this hunt although the harvest has been reduced to a single annual strike due to the crash of the Cook Inlet beluga population in 1998 and their now-official status as a depleted species. A second annual strike has been allocated to the Alaska Native Marine Mammal Hunters’ Committee for Anchorage-area subsistence hunters who are not Tyonek residents (O’Harra, 2002; National Marine Fisheries Service, 2002, http://www.fakr.noaa.gov/protectedresources/whales/beluga/adn_articles/6_12_02_hunt.htm).

The gathering of wild celery, wild rhubarb, rosehips, and other plants occurs during the summer. High- and low-bush cranberries, salmonberries, blueberries, and crowberries are harvested in the fall. Winter is a time of relatively low activity in the annual cycle of subsistence life for west Cook Inlet residents. Hunting for ptarmigan, spruce grouse, and hare continues throughout the winter, and a few Tyonek residents trap furbearers from mid-November until the end of winter (State of Alaska, Dept. of Natural Resources, 1999).

III.C.3.e(2) Central Kenai Peninsula

The Kenaitze, a group of Dena’ina Athabascans, have made use of Cook Inlet natural resources for generations. The Kenaitze have dried and smoked fish and picked berries over the years without any direct relationship to size of personal income. A Kenaitze Tribal Fishery was first allowed by the State of Alaska, Dept. of Fish and Game in 1989. Fishing dates vary from year to year, and in 1995, fishing was conducted from May 1 to October 15. Fishing occurs primarily in coastal marine waters south of the mouth of the Kenai River and occasionally immediately upstream of the Warren Ames Bridge in Kenai. The tribal office reported the 1997 harvest at 142 chinook; 2,410 sockeye; 5 pink; and 191 coho salmon (State of Alaska, Dept. of Natural Resources, 1999).

Residents of Ninilchik and members of the Kenaitze Tribe subsist on fish resources—primarily salmon-that occur on the east side of Cook Inlet. Major resources harvested are salmon, halibut, and butter and razor clams. Established in 1993, the Ninilchik Traditional Council Fishery allows for a local subsistence salmon harvest. Fishing time varies but it is normally held from May 8 to September 30. The harvest totals for the 1997 season were 302 chinook, 241 sockeye, 99 coho, and 55 pink salmon (most recent harvest data). Ninilchik residents harvest moose in the fall after the fishing season is over (State of Alaska, Dept. of Natural Resources, 1999). The nutritional contribution of the wild food harvest to communities in the Kenai Peninsula Borough can be seen in Table III.C-29. The wild food harvest in five road-connected Kenai Peninsula Borough communities can be seen in Figure III.C-28.

III.C.3.e(3) Lower Kenai Peninsula

Residents of Seldovia, Port Graham, and Nanwalek are the primary subsistence harvesters of the lower Kenai Peninsula and, since the *Exxon Valdez* oil spill fouled local traditional clamming areas, residents of Nanwalek and Port Graham have used the area around Ninilchik for the harvest of razor clams. Subsistence harvest of fish, wildlife, and vegetation also occurs at the head and along the southern shore of Kachemak Bay (see Figure III.C-20). Area residents harvest seals, sea lions, and sea otters around Yukon Island and Tutka Bay. Primary waterfowl harvest areas are in the vicinity of Seldovia, Tutka, and China Poot bays and McKeon and Fox River flats. Seabirds and their eggs also are harvested. Along local shorelines, moose, black bear, and mountain goats are hunted. Port Graham and Nanwalek residents harvest salmon in Nanwalek and Koyuktolik ("Dogfish") bays. Seldovians gather berries in larger quantities than any of the other Kenai Peninsula subsistence communities (State of Alaska, Dept. of Natural Resources, 1999).

Resources preferred by Nanwalek and Port Graham are clams, moose, bear, and especially salmon. These resources provide large quantities of food during a short period of the year and also are preserved for use throughout the remainder of the year. A combination of commercial, subsistence, and rod-and-reel fisheries provide salmon for domestic use. Residents of Nanwalek and Port Graham participate in permitted general subsistence and personal use fisheries that have existed in upper Cook Inlet since 1991. These fisheries also are open to non-Natives. Dipnet fisheries take place on the Kenai and Kasilof rivers and on Fish Creek. A set gillnet fishery takes place on the Kasilof River from June 21 until closed by emergency order or when approximately 5,000-10,000 sockeye salmon have been taken. In addition, a general Kachemak Bay subsistence and personal-use salmon fishery has taken place since before Statehood. This fishery uses Fox River drainage salmon runs returning and hatchery stocks returning to the fishing lagoon on Homer Spit and to Fox Creek. In 1993, 326 permits were issued and 1,990 coho, 463 pink, 44 sockeye, 18 chum, and 6 Chinook salmon were harvested (State of Alaska, Dept. of Natural Resources, 1999). The number of households involved in the Port Graham subsistence salmon fishery from 1981-1999 can be seen in Figure III.C-29.

Other resources such as trout, cod, halibut, chitons, snails, and crabs generally are used fresh in season. Harbor seals and sea lions are highly valued marine mammals; they are harvested year-round and are extensively shared within the community. A variety of plants also are harvested in Kachemak Bay. Bull kelp, rockweed, and brown seaweeds are collected from intertidal areas, and shoreline areas provide seaside plantain, rye grass, beach pea, wild parsley, and cow parsnip. Seldovia, Kasitsna, and Jakolof bays are important areas for the harvest of marine invertebrates.

Often overlooked as a means of subsistence, gardening has been part of village life since Russian times. Potatoes, cabbage, and turnips were brought to the Kenai Peninsula by Russian settlers who planted subsistence gardens out of the need for fresh vegetables (Fall, 1981). A variety of local wild berries are picked; particularly low- and high-bush cranberries, rosehips, blueberries, moss berries, and wild raspberries. Locally harvested subsistence foods are distributed widely among community households. The annual round of harvests by residents of Nanwalek and Port Graham is depicted in Figure III.C-10 (State of Alaska, Dept. of Natural Resources, 1999). Annual round figures indicate the time of year, in units of quarter months, when the harvesting of a particular resource occurs. The figures indicate reported presence or absence of harvest during a particular quarter month but do not show intensity of effort. The wild food harvest in six Kenai Borough communities can be seen in Figure III.C-30.

III.C.3.e(4) Kodiak Island

The principal wild foods harvested and consumed by the Native communities of Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions in the Kodiak Island Borough are fish, 71% of the total annual harvest (salmon 52%); land mammals (14%); and shellfish (6%). Salmon consistently provide the major portion of the region's subsistence food, and sockeye is the most harvested. From 1985-1999, the annual average harvest for the region ranged from 16,177 fish to 43,737 fish. Marine mammals make up 4%, plants 3%, and birds and eggs 2% of the total annual harvest. Major fish harvested by these communities are salmon, halibut, Pacific cod, Dolly Varden, and sablefish. Important land mammals taken are Sitka deer, moose, elk, and hare. Preferred marine mammals are the Steller sea lion and harbor seal. Primary shellfish varieties consist of tanner and Dungeness crabs and butter clams (see Figures III.C-21 and III.C-22). The nutritional contribution of the wild food harvest to communities in the Kodiak Borough can be seen in Table III.C-30, and the wild food harvest in seven Kodiak Borough communities can be seen in Figure III.C-31. The annual round of harvests by residents of Akhiok is shown on Figure III.C-11, for Karluk on Figure III.C-12, for Larsen Bay on Figure III.C-13, for Old Harbor on Figure III.C-14, for Ouzinkie on Figure III.C-15, and for Port Lions on Figure III.C-16 (www.dced.state.ak.us/cbd/AEIS/Kodiak/Subsistence/Kodiak_Subsistence_Narrative.htm; USDOI, MMS, Alaska OCS Region, 1995).

III.C.3.e(5) Southern Alaska Peninsula

The principal wild foods harvested and consumed by the Native communities of Chignik, Chignik Lagoon, Chignik Lake, Ivanof Bay, and Perryville in the Lake and Peninsula Borough are fish, 58% of the total annual harvest (salmon 48%); land mammals (33%); and marine mammals (3%). Salmon consistently provides the major portion of the region's subsistence food, and sockeye is the most harvested. From 1985-1999, the annual average harvest for the region ranged from 62,877 fish to 110,335 fish. Shellfish, plants, and birds and eggs each make up 2% of the total annual harvest. Major fish harvested by these communities are salmon, halibut, herring, and Pacific cod. Important land mammals taken are caribou, deer, moose, and brown bear. Preferred marine mammals are harbor seals, ringed seals, sea lions, sea otters, and occasionally beached (primarily gray) whales. Primary shellfish varieties consist of tanner and Dungeness crabs, littleneck and butter clams, chitons, cockles, and sea urchins (see Figures III.C-23 and III.C-24). The nutritional contribution of the wild food harvest to Southern Alaska Peninsula communities can be seen in Table III.C-31 and the annual round of harvests by residents of the communities of Chignik, Chignik Lagoon, and Chignik Lake is shown on Figure III.C-17 (www.dced.state.ak.us/cbd/AEIS/Kodiak/Subsistence/Kodiak_Subsistence_Narrative.htm; USDOI, MMS, Alaska OCS Region, 1995).

III.C.3.f. Annual Cycle of Harvest Activities

Table III.C-6 shows the years that subsistence-harvest inventories were published for communities and selected Census Designated Place areas within that part of Alaska that potentially could be affected by Sales 191 and 199. These inventories generally were based on household sample surveys of annual subsistence harvests and contained information on dressed weights of wild foods produced by resource type or species. Other settlements in Alaska also might be affected by the lease sales, but the communities and places shown are meant to reasonably represent the area that potentially could be affected. The number of households enumerated in the 1990 and 2000 U.S Censuses is shown to illustrate the size of the respective communities and to give a sense of the numbers of people seeking subsistence resources.

III.C.3.f(1) Characteristics of Harvest Activities

Table III.C-7 shows some characteristics of community subsistence harvests within the area that potentially could be affected by the lease sales. These characteristics include total per-capita harvest in pounds of edible wild food and the percentage of households that used, harvested, received, and gave away subsistence resources. This subsistence-harvest information indicates relative patterns of use over the survey years available. Specific characteristics of subsistence-harvest activities by community can be found in Fall et al., 2000; Fall and Utermohle, 1999; Schroeder et al., 1987; Reed, 1985; Wolfe and Ellanna, 1983; Fall, Foster, and Stanek, 1984; Morris, 1987; and Stanek, 1985.

Subsistence harvests, measured in usable pounds per person per year, ranged from 38 pounds (17 kilograms) in Kenai (1982) to 863 pounds (391 kilograms) in Karluk (1982) (most representative survey years). By geographic area, harvest products among the upper Cook Inlet and Kenai Peninsula Alaskan Native communities of Tyonek, Nanwalek, and Port Graham ranged from 122 pounds (55 kilograms) in Port Graham in 1989 (the year of the *Exxon Valdez* oil spill) to 305 pounds (138 kilograms) in Nanwalek in 1993, with an average for the three communities of about 237 pounds (107 kilograms) per capita. Useable harvest products among the other Kenai Peninsula communities (Fritz Creek, Homer, Kenai, Nikolaevsk, Ninilchik, and Seldovia) ranged from 38 pounds (17 kilograms) in Kenai to 205 pounds (93 kilograms) in Seldovia, with an annual average of 110 pounds (50 kilograms) per capita. On Kodiak Island, the nonroad-connected communities (Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions) showed per-capita harvests ranging from 89 pounds (40 kilograms) in Ouzinkie (in 1989, the year of the *Exxon Valdez* oil spill) to 863 pounds (391 kilograms) in Karluk, with an average for the communities of 330 pounds (150 kilograms) per capita. Elsewhere on Kodiak Island (Kodiak City, Chiniak, and the Kodiak Coast Guard Station), the harvests ranged from 115 pounds (52 kilograms) in Kodiak to 217 pounds (98 kilograms) in Chiniak, with an average of 154 pounds (70 kilograms) for the three sites. The Chignik communities (Chignik, Chignik Lagoon, Chignik Lake, Ivanof Bay, and Perryville) had usable harvests ranging from 188 pounds (85 kilograms) in Chignik to 490 pounds (222 kilograms) in Ivanof Bay, with an average of 341 pounds (155 kilograms) per capita.

These data indicate that very large amounts of subsistence foods are harvested in each of these geographic areas. These subsistence foods include salmon, other nonsalmon fish, big game, small game and furbearers, marine mammals, birds and eggs, marine invertebrates, and plants and berries. The harvest and use of these foods represent activities having significant social and cultural meaning in addition to economic importance, especially within predominantly Alaskan Native communities. Extensive sharing is commonplace, as suggested in Table III.C-7, by the high percentage of households in these communities that receive and give away subsistence resources.

Table III.C-8 shows the use of subsistence foods over a range of survey years as represented by the percentage of consumable resources in selected resource categories for the 22 communities within the potentially affected area. The table clearly indicates the importance of salmon for all communities, ranging from 38% of total consumable resources in Nanwalek (in 1987) to more than 70% in Tyonek (72% in 1983), Chignik (73% in 1984), and Karluk (77% in 1989). Nonsalmon fish are heavily represented in Nanwalek (37% of total consumable resources in 1987), Port Graham (49% in 1989), Seldovia (33% in 1991), Ouzinkie (33% in 1990), Port Lions (35% in 1982), Larsen Bay (31% in 1990), and Chignik (31% in 1991), with relatively less use elsewhere. Big game is used within the potentially affected area, ranging from less than 1% in Port Graham (in 1997) to 48% of total consumable resources in Chignik Lake (1989), in Nanwalek use ranges from 3-5%, and in Port Graham from less than 1-2%. The highest use of big game is found among the Chignik communities (7% in Chignik, 17-26% in Chignik Lagoon, and 34-48% in Chignik Lake); several Kodiak Island communities, Tyonek, and Ninilchik reported big game as 40% of their total consumable resources in 1998. Marine mammals are shown to be highly used in Akhiok (30% in 1982) and Old Harbor (25% in 1986); elsewhere, use ranges from 1-14% of total resources. Birds and eggs represent a relatively small proportion (1-7%) of total consumable resources. Marine invertebrates represent a considerably larger proportion of total consumable resources, ranging from 1% in Chignik Lake (1984), 18% in Ninilchik (1982) and Larsen Bay (1991), and 19% in Seldovia (1993).

III.C.3.f(2) Geography of Harvest Activities

Figure III.C-18 through III.C-24 show the geography of harvest activities for the communities in the potentially affected area. Figures III.C-18 and III.C-19 depict the inland and coastal resource harvest areas for Tyonek in upper Cook Inlet from 1978-1984 along with the clusters of fish camps and set net sites located south of the community to Granite Point (Fall, Foster, and Stanek, 1984). Resource-harvest areas for the communities of Nanwalek and Port Graham are shown in Figure III.C-20. Residents from both communities use this area although the English Bay and Port Graham Rivers are used primarily by residents of the respective communities (Stanek, 1985). Harvest areas are shown in Figures III.C-21 and III.C-22 for the six roadless communities on Kodiak Island. Figure III.C-23 shows the resource-harvest areas used from 1962-1982 by residents of Chignik and Chignik Lagoon, and Figure III.C-24 shows the resource-harvest areas used between 1962 and 1984 by residents of Chignik Lake, Ivanof Bay, and Perryville. Subsistence survey information above represents either the date of last subsistence survey in the community or the most representative survey year.

III.C.4. Sociocultural Systems

The sociological concept of "place" comprises three components that are key elements in understanding sociocultural systems. First, "place" is essential and spiritual, that is, it has a fixed and true meaning based on social facts and is an engulfing ideology. Second, it is socially constructed, which means it is negotiated, dynamic, and contested over time. This takes into account what the "place" was like in the past, what it has become, and how it has changed. Finally, "place" is based on geography, which means it has boundaries, and residents are connected to the environment as a geographic location where daily "social action" occurs.

Table III.C-9 shows selected places in Southcentral Alaska that could be affected by Sales 191 and 199. This list of places differs from that used in Section III.C.3 (Subsistence-Harvest Patterns). As noted in that section, other settlements in Alaska also might be affected by the lease sale. However, the communities and places listed in the table reasonably represent the area that could be affected by the lease sales. Table III.C-10 presents a general typology for integrating demographic, economic, and sociocultural characteristics of places in the area. Generally, the following terms apply:

- "Villages" have small populations and little growth through immigration, a dominant commercial-fishing and subsistence orientation, and are defined by Native Alaskan cultural practices and kinship ties.
- "Cities" exhibit relatively large populations and grow primarily through inmigration of residents, have mostly a wage-market sector economy, and a non-Native culture; that is, a low salience for extended kinship and tribal organization.
- "Towns" exhibit the dominant demographic, economic, and sociocultural characteristics of cities but have sizeable and important commercial-fishing and subsistence orientation and Native Alaskan cultural practices. Very often, towns are residential areas that have commercial, cultural, and social connections to nearby cities in the region.

III.C.4.a. Characteristics of the Population

This discussion covers population change over the last decade (1990-2000), ethnic composition of the population in 2000, and selected household and family characteristics of the 2000 population.

III.C.4.a(1) Population Change

Table III.C-9 shows the 1990 and 2000 decennial census population counts, in addition to the population increase or decrease for the decade, for selected cities and Census Designated Places-named areas within Southcentral Alaska. The population data are organized among the following geographic areas: upper Cook Inlet, central Kenai Peninsula, southern Kenai Peninsula, Kodiak Island (which includes all islands within the Kodiak Archipelago), and upper Alaska Peninsula (locally referred to as the Chigniks).

While many communities in the area experienced double- or triple-digit population increases in the decade, others experienced double-digit population reductions. In upper Cook Inlet, the community of Tyonek experienced a 25.3% increase in population. On the central Kenai Peninsula, Clam Gulch, Cohoe, Kasilov, Nikiski, and Sterling experienced substantial population increases. The incorporated communities of Kenai and Soldotna had less than 10% population growth. Two communities, Ridgeway and Salamatof, experienced slight population declines.

Most southern Kenai Peninsula communities grew during the period. Anchor Point experienced the largest growth, more than doubling in population during the decade with a 113% increase. Ninilchik had the second-largest population increase, followed closely by Fox River and Happy Valley. The three communities of Halibut Cove, Nikolaevski, and Seldovia had population declines.

The pattern of population change on Kodiak Island differs from that of the Kenai Peninsula. Population increase, where it occurs, is more moderate, barely exceeding 15% at Port Lions and 11% at Womens Bay. The City of Kodiak's population declined slightly. Other communities, such as Old Harbor, Larsen Bay, Chiniak, and Karluk, experienced much greater population decreases.

On the upper Alaska Peninsula, the five communities of the Chigniks recorded a mix of population change over the decade. Chignik lost more than half its population, while Chignik Lagoon nearly doubled its population. Ivanof Bay's population declined approximately 37%, while Perryville's population decrease was marginal.

III.C.4.a(2) Ethnic Composition of the Population

Table III.C-11 shows a selected representation of the ethnic composition of the 2000 population within the area that could be affected by the lease sales, identifying the Alaskan Native, Asian-American, and "two or more" ethnic group populations that exist among the predominantly Caucasian majority. Some of the smaller communities ("villages" in the typology) have predominantly Alaska Native populations, such as Tyonek in the upper Cook Inlet area, and Nanwalek and Port Graham on the southern Kenai Peninsula. On Kodiak Island, the Asian-American community exceeds the Alaskan Native community. All of the nonroad-connected communities on Kodiak Island are predominantly composed of Alaskan Native residents, including Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions. In the Chigniks, the communities of Chignik Lagoon, Chignik Lake, Ivanof Bay, and Perryville are predominantly Alaskan Native communities, whereas the City of Chignik is more diverse.

III.C.4.a(3) Selected Characteristics of the Population

Table III.C-12 shows selected characteristics of the year 2000 population within the area, including the number of households per community, the average number of persons per household, and the median age of residents in the community. Among the communities with populations of more than 1,000 residents, the City of Homer in 2000 had both the lowest average number of persons and the highest median age per household. The City of Kodiak had the highest average number of persons per household, and the City of Soldotna registered the lowest median age. These characteristics were distributed within these limits among the other large communities. Among the other communities of the upper Cook Inlet and central Kenai Peninsula, median age ranged from 28.3 in Tyonek to 39.6 in Kasilof. The average number of persons per household ranged from 2.58 in Clam Gulch to 4.34 in Salamantof.

In the southern part of the Kenai Peninsula, the lowest median age in 2000 was registered among the residents at Fox River and Nikolaevski, whereas the highest median age was found at Halibut Cove. The lowest numbers of persons per household were found in Halibut Cove and Seldovia, while the highest were in Fox River and Nanwalek. The predominantly Alaskan Native communities of Nanwalek and Port Graham demonstrated quite different characteristics, with Nanwalek having a younger population and a larger number of persons per household than Port Graham.

Among the small, nonroad-connected communities on Kodiak Island and in the Chigniks, the highest numbers of persons per household in 2000 were found in Akhiok and Chignik Lake. The lowest numbers of persons per household were found in Chiniak and Ivanof Bay. Considering the median age of the population, Akhiok and Chignik Lake registered the lowest, whereas Chiniak and Chignik recorded the highest.

III.C.4.b. Social Characteristics of the Communities

As indicated by Table III.C-10, the communities within the area that could be affected by the lease sale are grouped for discussion purposes into the major population and commercial-industrial centers, the nearby towns that have links to the centers, and the smaller, nonroad-connected communities, “villages” in the upper Cook Inlet and Kenai Peninsula area and the Kodiak Island and upper Alaska Peninsula area.

III.C.4.b(1) Upper Cook Inlet and Kenai Peninsula Communities

Fishing, tourism, oil and gas, and government undergird the Kenai Peninsula’s diversified economic, social, and commercial activities (Fried and Windisch-Cole, 1999a:50). As indicated by Table III.C-10 and Table III.C-13, the sociocultural systems of these large coastal communities are supported by a diversified economic base with sizeable growth through inmigration. As shown by Table III.C-9, much of the recent growth has occurred in associated areas or communities near the cities. For example, while the City of Kenai experienced a modest population increase, the associated residential areas experienced much large growth. As indicated by Table III.C-13, services for the residents of the central Kenai Peninsula area center on “city” of Kenai, Soldotna, Nikiski, and the nearby residential areas such as Sterling, Ridgeway, Salamatof, and Kasilof. For residents of the southern Kenai Peninsula, the “city” of Homer area serves a similar function but on a smaller scale. This area encompasses the City of Homer and the residential areas of Fritz Creek, Anchor Point, Nikolaevski, Ninilchik, and Kachemak.

III.C.4.b(1)(a) Kenai-Soldotna Area

The social fabric and economy of the Kenai-Soldotna area have been shaped since the late 1950’s predominantly by the discovery and development of oil and gas resources nearby on the Kenai Peninsula and in Cook Inlet (USDOI, MMS, Alaska OCS Region, 1984:4,450). The local petroleum industry spawned associated industries such as refining and chemical manufacturing. It also provided important services to North Slope oil fields. As a consequence, a significant number of the Peninsula’s residents commute from the Kenai to North Slope oil fields. Construction of modules for the Alpine oil field, represented an important new petroleum activity for the area. Overall, the mature petroleum industry remains an important part of the economy and may continue as the single largest source of well-paying, nonseasonal jobs in the area (Fried and Windisch-Cole, 1999a:50). Recent job losses in the oil industry reflected the completion of the Alpine module construction project in 2000. New oil finds and gas strikes led to a rebound in oil and gas industry activity in Cook Inlet later that year (Fried et al., 2002:90).

Tourism and recreation is a growing sector of the social and economic composition of the communities. Sport fishing is the largest single attraction on the Peninsula. The Kenai River, which flows through the area, supports the largest sport fishery in Alaska. Retail establishments, services, construction, and public sector services also make important contributions to the diversity of the area (Fried and Windisch-Cole, 1999a:50).

The largest concentration of the area’s population resides in the areas immediately outside the cities of Kenai and Soldotna. As indicated by Table III.C-9, growth in most of the surrounding areas was considerably greater than that experienced by the cities.

III.C.4.b(1)(b) Homer Area

The Homer area is more sparsely populated than the Kenai-Soldotna area and is economically dependent on commercial fishing and tourism. A number of residents work elsewhere in the state or have chosen Homer as the place to retire. The area also has a thriving art community. The commercial-fishing fleet is centered in Homer, and the port hosts a sizeable sport-charter-boat fleet. The natural beauty of the area is held to be a major attraction supporting the visitor industry (Fried and Windisch-Cole, 1999a:50). Recent employment declines in the seafood industry appear to be permanent. The Cook Inlet salmon harvest downturn took its toll on the area’s processing employment (Fried et al., 2002:90).

III.C.4.b(1)(c) Small, Nonroad-Connected Communities

The small, nonroad-connected communities in upper Cook Inlet include Tyonek, Nanwalek, Port Graham, and Seldovia. The communities, with the exception of Seldovia, are classified as “villages” under the typology presented in Table III.C-10. Residents of Tyonek are predominantly Tanaina (Dena’ina) Athabaskan Indians whereas residents of Nanwalek and Port Graham are predominantly Alutiiq people who locally think of themselves as Aleuts (Braund and Behnke, 1980); Seldovia is more heterogeneous than the other communities. As indicated by Tables III.C-10 and III.C-13, the sociocultural systems of these small coastal communities are supported by a limited economic base, with commercial fishing and seafood processing as the primary income-producing occupations. Maintenance of subsistence activities is considered central to the social well-being of the communities of Tyonek, Nanwalek, and Port Graham and less so in Seldovia; however, Alaskan Native residents in Seldovia appreciate the importance of these activities. In Tyonek, for example, hunting and fishing patterns more closely resemble those of communities such as Nondalton and Dot Lake than those of communities on the nearby Kenai Peninsula (Fall, 1983). Subsistence activities in Tyonek are characterized by a well-established annual round of hunting, fishing, and gathering activities; the use of a wide range of marine and land resources; and a kinship-based system for the harvest, processing, distribution, and exchange of wild-resource products (Schroeder et al., 1987).

In Nanwalek and Port Graham, which are classified as "villages" in the typology presented in Table III.C-10, a considerable network of resource sharing and distribution exists within each community because the communities are closely related by family ties, common hunting and fishing practices, and local customs. Russian Orthodox holidays, name days, and birthdays, among others, are occasions for celebration, and use locally harvested foods, and many daily meals of families in these communities incorporate similar resources. Subsistence- and commercial-fishing activities, in addition to visiting, recreation, and political relationships, are primarily based on the complex web of kinship networks and family relationships in these communities. Residents feel a strong bond to their communities, both to the physical surroundings and to their relatives and friends (Braund and Behnke, 1980, 2001).

Seldovia, on the other hand, is a multiethnic community that has a character similar to other rural, white, frontier fishing towns. In the typology of places presented in Table III.C-10, Seldovia is classified as a "town" relative to other places in the study area. Seldovia in the early 1900's was a thriving commercial-fishing community and the center for commercial and social life for all of Kachemak Bay and Cook Inlet (Reed, 1983). Many Scandinavian and other fishermen immigrated to Seldovia and intermarried with the local population. It was not until the 1960's that other commercial centers outgrew Seldovia and diminished its commercial importance. Seldovia today has a sizeable, yet declining, Alaskan Native population (see Tables III.C-9 and III.C-12).

III.C.4.b(2) Kodiak Island and Upper Alaska Peninsula Communities

Table III.C-13 presents a brief overview of the social and economic characteristics of the area's communities. The City of Kodiak and its surrounding road-connected residential areas provide diversified social, commercial, and other services for residents of Kodiak Island, in addition to an important commercial-fishing port. (However, in the typology of places presented in Table III.C-10, the City of Kodiak is classified as a "town" relative to other places in the study area.) Residential areas outside Kodiak proper include places such as Chiniak, the Kodiak U.S. Coast Guard Station, and Womens Bay. A similar core area does not exist among the upper Alaska Peninsula communities.

III.C.4.b(2)(a) Kodiak Area

The City of Kodiak is the largest and most culturally diverse community on Kodiak Island, representing different cultural backgrounds and traditions. Kodiak originated in the Russian era and evolved into a commercial-fishing center before the turn of the century. The emphasis on fishing continues to the present and has been a unifying force in the community. A less seasonal and more dependable year-round economy for the community was established in the late 1940's with diversification into crab and other species. Kodiak's downtown waterfront district was severely damaged by a tsunami generated by the 1964 earthquake, but the area was almost entirely rebuilt by 1970. Today, Kodiak is the home of the largest commercial-fishing fleet in Alaska (Fall et al., 2001; USDOI, MMS, Alaska OCS Region, 1984:440). While fishing and related processing dominates the economy, the U.S. Coast Guard station, tourism, timber, and the nearby Kodiak space launch facility make important contributions to the economy (Fried and Windisch-Cole, 1999b).

The interests and concerns of the fishing industry permeate Kodiak's entire social fabric. In keeping with fisheries traditions, a relatively large group of resident and transient workers who process the catch are supported onshore. Like the fishing fleet and shore-side workers, other residents of Kodiak also are drawn into the predominantly fisheries way of life, with its danger, intensity, and commitment as well as its recreational, social, and political imperatives. The isolation and relatively small size of the Kodiak area encourage rapid organization and mobilization around key issues affecting the community. Issues that could affect the fisheries way of life have tended to mobilize considerable unity within the community (Fall et al., 2001; Impact Assessment, Inc., 2001; USDOI, MMS, Alaska OCS Region, 1984).

III.C.4.b(2)(b) Small, Nonroad-Connected Communities

The small, nonroad-connected communities of the Kodiak Island and upper Alaska Peninsula area that could be affected by the lease sales include Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions on Kodiak Island and Chignik, Chignik Lagoon, Chignik Lake, Ivanof Bay, and Perryville on the upper Alaska Peninsula. All these communities are classified as “villages” under the typology presented in Table III.C-10.

This description is based primarily on the results of an MMS-sponsored study of the small communities on Kodiak Island and the upper Alaska Peninsula (Cultural Dynamics, Ltd., 1986a). All of these communities are physically isolated yet linked by year-round air transportation to other Alaskan communities and regional centers. In addition to providing a detailed description of the area, the study found that:

- dual residency is an established pattern among the five Alaska Peninsula communities;
- social and kinship links appear greater between the southern Kodiak Island communities and the Alaska Peninsula, and between Chignik and Kodiak City, than between the southern and northern Kodiak communities; and
- several traditional family patterns—such as households containing three generations of people—persist, especially in the southern Kodiak communities.

The Kodiak/Alaska Peninsula area includes three very old communities (Karluk, Akhiok, and Chignik); three relatively new communities (Chignik Lake, Ivanof Bay, and Port Lions) established since 1950; and a shared linguistic and cultural foundation. These Alutiiq people experienced Russian influences, especially in the northern Kodiak Island area, and the rapid expansion of commercial salmon fisheries and canneries in the late 19th century, where influences were felt especially strongly in the Karluk, Chignik, and Chignik Lagoon areas from cannery operations located nearby. The Scandinavian influence was greatest in the Chignik and Chignik Lagoon areas. Contact between the upper Alaska Peninsula area and Kodiak Island may have been frequent in the first part of the twentieth century, with travel, visiting, and intermarriage occurring during the fur-trading and early commercial-fishing period. Kinship ties through marriage continue to link the Kodiak Island communities with the Pacific coast side of the Peninsula; there are very few marriages between residents born on the southern end of Kodiak Island, especially Old Harbor and Akhiok, and northern-end residents. Community migration patterns emerging in the period from 1984-1985 indicated a movement of families from a smaller to the nearest larger community on Kodiak Island—from Karluk to Larsen Bay, from Akhiok to Old Harbor, and from Ouzinkie to Port Lions.

Seasonality of residency in the Kodiak Island and upper Alaska Peninsula communities is based on the rhythms of commercial fishing. This is more marked on the Alaska Peninsula than on Kodiak Island, with Chignik and Chignik Lagoon expanding greatly in June when many residents from the other communities migrate for summer salmon fishing. However, as indicated by Table III.C-9, Chiniak, Larsen Bay, Karluk, Old Harbor, Chignik, and Ivanof Bay experienced significant overall population declines between 1990 and 2000.

III.C.4.b(2)(c) Fisheries Orientation

Most all the Kodiak Island and Chignik area communities share a tradition of commercial fishing, but the level of participation varies importantly from one community to another. According to Langdon (Cultural Dynamics, Ltd., 1986b), community groupings were evident in the early 1980’s based on participation in commercial fisheries. Chignik Lake, Perryville, and Ivanof Bay fishers were almost totally dependent on traditional salmon fishing with sparse evidence of investment in large boats or participation in winter crab fisheries. These traditional fishers were independent vessel owners, demonstrated greater reliance on kinsmen for crewmembers, and continued to maintain relationships with processors for services. Fishers from Chignik and Chignik Lagoon, on the other hand, showed more diversification, with some venturing into fishing king and tanner crab in the 1970’s. Fishers from these two communities tended to hire more nonrelatives and nonlocal crewmen, although there still was a strong reliance on kinsmen for salmon fishing. Ties with processors were very weak because these fishers bargained independently with local and outside processors.

A similar pattern of substantial involvement and diversification existed on Kodiak Island among the communities of Old Harbor, Port Lions, and Ouzinkie, although traditional fishers also were present. Of these communities, Port Lions appeared to be the most similar to the City of Kodiak in the size of vessels, the fisheries pursued, and the proportion of total earnings derived from different species.

A third community pattern was one of declining involvement in commercial fisheries, a pattern found in Larsen Bay, Akhiok, and Karluk—originally traditional salmon-oriented communities. Fishers from these communities had sold most of their permits, particularly set-gillnet permits, for a variety of reasons, such as poor local harbors, lack of vessel- and gear-storage facilities, natural disasters, and poverty. Although commercial fishing was still important to residents of Larsen Bay, participation was declining as those who could not or would not diversify left the fishery. Residents of Akhiok and Karluk appeared to be only minimally involved in commercial fisheries.

While salmon is nearly always one of the leading fisheries, Kodiak has the most diversified fishery in the State, and the dominant fishery can change in a short time. Island residents also fish in other Alaska waters. They participate in at least 27 different types of fisheries. More residents live off the fishing industry than anywhere else in Alaska. The commercial salmon fishery continues to attract new participants. Many fishers in Kodiak work in more than one fishery. More fishers have diversified their harvests, because fluctuations in prices and species availability make reliance on a single fishery risky (Fried and Windisch-Cole, 1999b).

III.C.4.c. Institutional Organization of the Communities

The communities that could be affected by the proposed lease sales are organized institutionally among units of local government, tribal organizations, community and regional Alaska Native Claims Settlement Act profit corporations, regional nonprofit Native organizations, and various special-purpose agencies (Fall et al., 2001).

III.C.4.c(1) Upper Cook Inlet and Kenai Peninsula

The communities of the upper Cook Inlet and Kenai Peninsula are organized under the Kenai Peninsula Borough, a second-class borough incorporated in 1964. The Borough includes most of the Kenai Peninsula and coastal lands on the west side of Cook Inlet. Seldovia incorporated as a first-class city in 1945, and Kenai incorporated as a home-rule city in 1960. Homer and Soldotna incorporated as first-class cities in the mid-1960's. Tyonek organized a tribal council for the community under the Indian Reorganization Act in the late 1930's; it remains today as the governing body for the community (Fall, Foster, and Stanek, 1984). Regional tribal organizations include the Cook Inlet Tribal Council and Chugachmiut, formerly known as the North Pacific Rim. Regional Alaska Native Claim Settlement Act corporations include Cook Inlet Region Inc. and Chugach Alaska Corporation.

III.C.4.c(2) Kodiak Island

Kodiak Island communities are incorporated into the Kodiak Island Borough, formed in 1963 as a second-class borough. The Borough also includes uninhabited coastal lands opposite the archipelago on Shelikof Strait. The City of Kodiak is a home-rule city, formed in 1940, whereas five of the nonroad-connected communities (except Karluk) incorporated as second-class cities in the late 1960's and mid-1970's. Tribal councils also exist in these communities. The Karluk Tribal Council was formed in 1939 and is recognized by the State of Alaska as the local government for the community (Cultural Dynamics, Ltd., 1986a). The Kodiak Area Native Association provides regional tribal services to most of the Native communities. Koniag, Inc. is the regional Alaska Native Claim Settlement Act Corporation for the communities on Kodiak Island.

III.C.4.c(3) Upper Alaska Peninsula

The five communities located in the Chignik area are part of the Lake and Peninsula Borough, formed in 1989 as a home-rule borough. Chignik is the only second-class city, having incorporated in 1983. A tribal council also exists in Chignik. The other communities are governed by traditional tribal councils. The communities also are served regionally by the Bristol Bay Native Corporation and the Bristol Bay Native Association.

III.C.5. Recreation, Tourism, and Visual Resources

The Cook Inlet's many recreational values require some access to the outdoor environment. Many recreational uses involve public lands and depend on the use of public water bodies (Kenai Peninsula Borough, 1999). Recreation activities may be classified as "coastal-dependent" or "coastal enhanced." Coastal-dependent activities require access to the coastline and water for the activity to take place. These endeavors include boating, fishing, sailing, kayaking, marine wildlife viewing, and beachcombing. Coastal-enhanced activities, while not directly dependent on access to the coastline and water, derive increased quality to participants because of the proximity to the coast. These endeavors include hiking, biking, running, nature appreciation, camping, photography, and horseback riding.

The recreation values of the region and tourism are linked. Recreation values contribute to the quality of life for Alaska residents, and, through the expenditures made in their pursuit, recreation values contribute to the area's economy. In turn, these values are an important component of tourism, acting to attract in-State and out-of-State pleasure tourists to the area. Much of the recreation and tourism activities in the area use the region's scenery, rivers, and lakes, coastal waters, and abundance of fish and wildlife resources (Kenai Peninsula Borough; 1989 McDowell Group, 1991). For example, a 1999 survey estimated that 60% of the adults in Anchorage traveled to the Kenai Peninsula, 35% for freshwater fishing, 32% for ocean fishing, and 21% for sightseeing (Camp, 1999).

The scenic quality of the area enhances the setting for coastal-dependent and coastal-enhanced recreation and is a major attraction in itself. Sightseeing as an Alaskan tourist activity is more than 100 years old and uses a variety of modes, including waterborne tours and cruises and airborne flightseeing (McDowell Group, 1991; Fried, 1999). The natural beauty of the area is cited as an important factor in attracting visitors (Fried, 1999). The entire coastline of the Cook Inlet basin holds an abundance of vistas, natural features, and manmade scenic resources of varying aesthetic value. Scenic resources may include wetlands, tidal flats, beaches, vertical bluffs, rocky coasts, lakes, stream corridors, undulating hills, bays, and inlets. These scenic resources may be enclosed in a wooded canopy or open with one or more unique natural features in view. Scenic resources also may include manmade attractions, such as the Anchorage skyline. The position of the observer is always key in characterizing scenic resources (Kenai Peninsula Borough, 1999).

State of Alaska coastal management standards and the Lake and Peninsula Borough's and Kenai Peninsula Borough's local coastal plans recognize the nexus between recreation, tourism, and visual resources. Recreation areas designated by districts under the State coastal management standard for recreation, 6 Alaska Administrative Code (AAC) 80.060, include locations that are major tourist destinations or that receive significant use by persons engaging in recreational pursuits. Using the criteria of this standard, the Lake and Peninsula Borough includes in its plan the activities of sport fishing; hunting; hiking; photography; boating; and the viewing of fish, wildlife, and scenic areas. Recreation-use areas encompass the Federal Conservation Units and the Nushagak and Mulchatna Rivers Recreation Management Plan Areas Meriting Special Attention (State of Alaska, Office of the Governor, Div. of Governmental Coordination, 1999). In its plan, the Kenai Peninsula Borough designates for recreational use:

- State, Federal, and local parks, trails, and recreational facilities;
- public land or water that receives significant use by sport fishermen, clam diggers, or recreational users; and
- public land or waters that have high potential for recreational use because of physical, biological, or cultural features (Kenai Peninsula Borough, 1990).

Section III.C.9 describes the recreation and scenic values of the national and State parks and special use areas in the Cook Inlet area. In addition, the Kenai Peninsula Borough's local coastal plan identifies the areas listed in Table III.C-14 as potentially meriting special attention, in part, because of their scenic qualities and recreation qualities. While other areas could be included, these locations reasonably represent the area.

III.C.6. Sport Fisheries

The marine sport fisheries of Cook Inlet are the focus of a large and growing recreation-based economic sector. Sport fishing provides monetary benefits to tourism-related businesses. Sport fishing in Cook Inlet is primarily for Pacific halibut. The marine salmon fishery (i.e., chinook and coho) is both a substitute and complement for the halibut sport fishery. Halibut sport-fishing catches in Cook Inlet have gradually increased from 1977-1998. Also, the percentage of halibut sport fishing of the total of sport and commercial halibut fishing has increased steadily between 1977 and 1998. Another increase related to sport fisheries has to do with vessels: the number of vessels licensed for sport or sport/commercial fishing off Alaska has increase steadily from 500 in 1984 to more than 1,500 in 1996.

The person-days fishing on charters in lower and central Cook Inlet during 1997 total approximately 79,000; on private or bare-boat charters, 91,000; and shore-based, 28,000—with the total of all modes 198,000. Sport fishers include local fishers from the Kenai Peninsula, other Alaskans (from outside the Kenai Peninsula), and nonresidents of Alaska. The average daily expenditures for lower and central Cook Inlet sport-fishing trips in 1997 and 1998 ranged from $32 for a local resident fishing from shore to $294 for a nonresident of Alaska on a charter. Costs included in these expenditures include automobile or truck fuel, automobile or recreational vehicle rental, airfare, other transportation, lodging, groceries, restaurant and bar, charter or guide, fishing gear, fish processing, derby fees, boat fuel and repairs, and moorage or haulout. The total expenditures by all sport fishers fishing in lower and central Cook Inlet directly attributable to a saltwater halibut and salmon fishing trip in 1997 was $34 million.

The sport-fishing charters and shore-based fishing include: Anchor River, Whiskey Gulch, Deep Creek, and Ninilchik River; other Cook Inlet and Gulf Coast west of Gore Point; other Cook Inlet north of the Ninilchik River; Barren Islands, Seldovia; Homer Spit; and various points along the shoreline (derived from Herrmann, Todd, and Hamel [2001]; Lee et al. [1999]).

In addition to the waters of Cook Inlet, Kachemak Bay and the rivers and streams flowing into Cook Inlet account for a large proportion of the total sport-fishing effort for the entire State (Northern Economics, 1990:78). The most popular freshwater sport fishing on the rivers and streams of the Kenai Peninsula are:

- Kenai River king salmon in June
- Russian River sockeye salmon in June
- Kasilof River king salmon in June
- Lower Kenai Peninsula salmon (Deep Creek, Ninilchik Creek, Anchor River, Homer Spit, and Halibut Lagoon) in June
- Second-run Kenai River fishery in July
- Silver salmon fisheries on all rivers and streams on the Kenai Peninsula beginning in the latter part of July and running through September and later

People gather razor clams (*siliqua patula*) and other clams (for example, *Myra* spp. and *Macoma balthica*) at various locations along the western side of the Kenai Peninsula and other shoreline areas bordering Cook Inlet. People collect steamer clams, mussels, and various other shellfish in Kachemak Bay. For a description of the location of these species and their habitat, see Section III.B.1.b - Lower Trophic-Level Organisms, Section III.C.2.a - The Shellfish Fishery, and a NOAA web site (www.nwfsc.noaa.gov/hab.newsletter/hab).

The saltwater sport fishery in Cook Inlet, freshwater sport fishery on the Kenai Peninsula, and clamming on the shores of Cook Inlet are an important part of the overall economy. For more information on the economy of the Kenai Peninsula Borough, see Section III.C.1. Sport fisheries also are an important part of recreation and tourism. For more information on recreation and tourism, see Section III.C.5. For more information on national and State parks, which are also integral to the sport fisheries industry, see Section III.C.9.

III.C.7. Environmental Justice

Alaskan Natives, a recognized minority, are the primary residents in the Cook Inlet Region to consider in any Environmental Justice analysis. Nevertheless, any low-income or minority population that potentially could experience disproportionate, high-adverse effects from Cook Inlet multiple-sale activities would be part of the analysis.

Effects on residents in Athabascan, Alutiiq, and Koniag communities and minority populations in larger non-Native communities adjacent to the Cook Inlet multiple-sale area could occur because of their reliance on fishery resources and subsistence foods. The OCS oil and gas exploration and development could affect these resources as well as subsistence-harvest practices.

Environmental Justice is an initiative that culminated with the February 11, 1994, Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, and an accompanying Presidential memorandum. The Executive Order directs each Federal Agency to consider Environmental Justice part of its mission. Its intent is to promote fair treatment of people of all races, so that no person or group of people shoulders a disproportionate share of the negative environmental effects from this country's domestic and foreign programs. It focuses on minority and low-income people, but the Environmental Protection Agency defines Environmental Justice as the "equal treatment of all individuals, groups, or communities regardless of race, ethnicity, or economic status from environmental hazards" (U.S. Department of Energy, 1997; Envirosense, 1997). Specifically, the Executive Order requires an evaluation in the EIS as to whether the proposed project would have "disproportionately high adverse human health and environmental effects…on minority populations and low income populations."

Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*, directs the MMS to consult with tribal governments in the Cook Inlet region on Federal matters that could significantly or uniquely affect their communities. The Environmental Protection Agency's own Environmental Justice guidance of July 1999 stresses the importance of government-to-government consultation. The MMS has met with tribal governments as part of the Cook Inlet environmental assessment process. The MMS has come to appreciate the potential overload to stakeholder institutions that can occur from too many planning and public meetings and has been sensitive to this in planning the number and timing of meetings with Cook Inlet tribal groups and local governments. Since 1999, all MMS public meetings have been conducted under the auspices of Environmental Justice and presentations on the Executive Order and how the MMS is addressing it have been made at scoping and government-to-government meetings. The Environmental Justice process followed for the Cook Inlet multiple sales included: (1) initial scoping, (2) notices in local newspapers, and (3) future followup meetings that included meetings specific to Environmental Justice concerns and mitigation. From this process, the MMS received feedback on specific Environmental Justice concerns and documented these various concerns of Native and minority residents. Environmental Justice concerns were taken back to MMS management and incorporated into environmental studies, designs, and new mitigating measures. Mitigating measures, stipulations, and Information to Lessee (ITL) clauses are being considered that address issues heard, for example, ITL No. 3 – Sensitive Areas to be Considered in Oil-Spill Response Plans has been revised to advise the lessee that the Port Graham/English Bay Area That Merits Special Attention be considered when developing oil-spill-response plans. Environmental Justice concerns were solicited in the Cook Inlet region from meetings with the communities of Homer on January 30, 2002; and Seldovia on January 31, 2002; from government-to-government meetings with the Seldovia Indian Reorganization Act Council on February 1, 2002, and in Nanwalek on February 8, 2002; in a public meeting and a meeting with the Nanwalek Indian Reorganization Act Council, in Ninilchik on February 8, 2002;, and in a public meeting and a meeting with the Port Graham Traditional Village Council in Port Graham on February 11, 2002. Major concerns expressed at these meetings included:

- potential contamination of subsistence resources from postlease and non-OCS activities (see Sections IV.B.1.p - Effects on Environmental Justice; see also the cumulative effects section at V.C.5.p - Environmental Justice);

- the need for specific plans to avoid impacts on subsistence resources (see Sections IV.B.1.1 - Effects on Subsistence-Harvest Patterns and IV.B.1.p - Effects on Environmental Justice; Sections IV.B.3 - Lower Cook Inlet Deferral and IV.B.4 - Barren Islands Deferral; and Section II.F - Stipulation No. 1 - Protection of Fisheries);
- deferral of the eastern portion of the lower Kenai Peninsula to protect subsistence resources (see Sections IV.B.3 - Lower Cook Inlet Deferral and IV.B.4 - Barren Islands Deferral);
- potential water-quality contamination from drilling discharges of subsistence resources and potential human health effects that might result (see Sections IV.B.1.a - Effects on Water Quality and IV.B.1.p - Effects on Environmental Justice);
- concerns about contaminants in subsistence foods and the need to address allowable levels of contamination and consumption levels appropriate to Alaskans (see Sections IV.B.1.1 - Effects on Subsistence-Harvest Patterns and IV.B.1.p - Effects on Environmental Justice);
- concern that an eddy off Port Graham, Nanwalek, and Seldovia may concentrate contaminants from other areas in Cook Inlet (see Sections IV.B.1.a - Effects on Water Quality and IV.B.1.p - Effects on Environmental Justice);
- the need for a followup subsistence contaminant study to the 1998 Environmental Protection Agency study (see Section IV.B.1.p - Effects on Environmental Justice);
- the need for tribes to be informed of contaminant studies' results before they are released to the public (see Sections IV.B.1.1 - Effects on Subsistence-Harvest Patterns and IV.B.1.p - Effects on Environmental Justice; see also the cumulative effects sections for these resources at V.C.5.1 - Subsistence-Harvest Patterns and V.C.5.p - Environmental Justice);
- the consideration of past and ongoing sociocultural impacts of the *Exxon Valdez* oil spill and cumulative impacts in general (see Sections IV.B.1.1 - Effects on Subsistence-Harvest Patterns and IV.B.1.m - Effects on Sociocultural Systems; see also the cumulative effects sections for these resources at V.C.5.m - Sociocultural Systems and V.C.5.p - Environmental Justice);
- oil spills and oil-spill-cleanup effects of cultural resources (see Sections IV.B.1.q - Effects on Archaeological Resources and Section VII - Responses to Comments);
- the need for tribes to have response equipment, community response training, and assistance for oil-spill cleanup (see Section IV.B.1.p - Effects on Environmental Justice and Section IV.A.5 - Spill Prevention and Response);
- improved communication with the village of Nanwalek (see Sections III.C.7 - Environmental Justice and IV.B.1.p - Effects on Environmental Justice);
- the importance of ongoing government-to-government communication with tribes (see Sections III.C.7 - Environmental Justice and IV.B.1.p - Effects on Environmental Justice);
- air-quality impacts in lower Cook Inlet (see Section IV.B.1.b - Effects Air Quality);
- the reduction of past impacts to subsistence resources (see Sections IV.B.1.1 - Effects on Subsistence-Harvest Patterns and IV.B.1.p - Effects on Environmental Justice; see also the cumulative effects sections for these resources at V.C.5.1 - Subsistence-Harvest Patterns and V.C.5.p - Environmental Justice);
- the identification and protection of critical habitat areas for sensitive fish and endangered species (see Sections IV.B.1.e - Effects on Essential Fish Habitat and IV.B.1.f - Effects on Endangered and Threatened Species);
- the need to reduce exploration and development conflicts with driftnet and setnet gear (see Sections IV.B.1.d - Effects on Fisheries Resources, IV.B.1.o - Effects on Sportfishing and II.F - Stipulation No. 1 - Protection of Fisheries); and
- the need for impact assistance to coastal communities (see Section IV.B.1.p - Effects on Environmental Justice).

III.C.8. Archaeological Resources

During the past few years, a number of new historic and prehistoric resources have been discovered onshore near the proposed multiple-sale area. Ethnological data collected in the 1930's, excavations at Yukon Island and Cottonwood Creek in the 1920's, and the discovery of a possible Tanaina village in the

1880's in Kachemak Bay are indications of the other resources that may lie undiscovered on the land around the proposed lease-sale area. Following in this section is a discussion of the general locations and pertinent descriptions of what was found.

The descriptions in this section of historic and prehistoric archaeological resources are a summary of the research in Mobley et al. (1990). Also consulted were publications by Clark, 1975a; de Laguna, 1932; and two BLM papers on cultural resources (Tornfelt, 1981, 1982). Shipwreck material comes from Tornfelt and Burwell (1992), shipwreck maps, and personal conferences and review by other knowledgeable individuals, including MMS archaeologists and geophysicists. For a more detailed discussion of the Quaternary geology of the sale area, see Section III.A.1, and for a more detailed discussion of the potential for submerged prehistoric resources within the sale area, refer to Appendix F of the Cook Inlet Sale 149 EIS (USDOI, MMS, Alaska OCS Region, 1995), and the Prehistoric Resources Analysis in Section III.C.8.b(1) below. The lease blocks that will require an archaeological report in accordance with CFR 250.194 are listed in Table III.C-15 and shown in Map 1.

III.C.8.a. Onshore Archaeological Resources

III.C.8.a(1) Prehistoric Resources

Numerous known prehistoric sites exist around the proposed multiple-sale area (USDOI, MMS, Alaska OCS Region, 1995:Figure III.C.5-2). Some new sites were discovered in 1989 during the *Exxon Valdez* oil-spill cleanup. These resources are discussed in the following geographical order: east coast of Alaska Peninsula resources, Kodiak resources, and Kachemak Bay and lower Cook Inlet resources. Within each of those geographical categories, resources are discussed in a time (phase) sequence (USDOI, MMS, Alaska OCS Region, 1995:Figure III.C.5-3).

III.C.8.a(1)(a) Prehistoric Resources of the East Coast of the Alaska Peninsula

Archaeologists generally agree that if one compares the discoveries on the east side of the Alaska Peninsula with the discoveries on the west side, it seems that the peninsula was a sort of boundary between the Pacific culture and the Bering Sea culture. However, there are few known sites for the Pacific coast of the Alaska Peninsula, and comparatively little research has been carried out there. The objective evidence for the time sequences comes from Kachemak Bay and from research by de Laguna (1934) and Clark (1975b).

Resources from 500-1800 B.P. – Mound, Beach, and Cottonwood Phases (USDOI, MMS, Alaska OCS Region, 1995:Figure III.C5-3): That the Mound Phase is continuous with the phase farther back in time called the Beach Phase and the much earlier one called the Cottonwood Phase is suggested by many objects of the chipped-stone inventory. Almost all new hunting-weapon-point types, however, are very similar to those found in Katmai National Park at Brooks River Falls, indicating interior Norton culture (Norton culture is the culture found by Giddings at Cape Denbigh at Norton Sound, Alaska [Giddings, 1964]). Clark's (1977) Beach Phase sample included just fewer than 900 stone and bone items and just fewer than 200 ceramic pieces (Mobley et al., 1990).

An early view of coast-interior relationships on the Alaska Peninsula during the Beach Phase was stated in Dumond's (1977) original synthesis of Alaska Peninsula prehistory, entitled *Eskimos and Aleuts, Archaeology of the Katmai Region*, which argues that because of the great similarity between the Brooks River Falls resources and the Pacific coast prehistoric resources, the people must have migrated across the peninsula. On the other hand, because Kodiak was not that similar to the other two resource sets, there is not an implication of migration to Kodiak (Mobley et al., 1990).

The resources around the proposed multiple-sale area indicate that this period was a time of an increasing flow of people and their culture from northern Norton Sound of Alaska to Kachemak Bay and vice versa. During the years 1500-1800 B.P. (Cottonwood Phase), few new types of projectiles are present, suggesting cultural continuity across the 1,000-year gap separating the Birch and Cottonwood phases. Both chipped- and ground-stone implements in use before the time gap still remained in use in the Cottonwood Phase.

Pottery, another resource of this period, is undecorated and strengthened with vegetable fiber and sometimes includes gravel. The only vessel type found has a flat bottom with slightly flared sides. The

Norton wares of the interior Alaska Peninsula groups are identical to this earliest of Pacific coast pottery. The Cottonwood Phase is of the same time period (1100-2000 B.P.) (USDOI, MMS, Alaska OCS Region, 1995:Figure III.C.5-3) as the earlier part of the late Kachemak (Three Saints Bay) phase on Kodiak and Kachemak III (1200-2000 B.P.) in Cook Inlet (Clark, 1966, l970a, as cited in Mobley et al., 1990; and Clark, 1975a). Chipped-stone projectile types (probably arrow tips) found all the way through the Beach Phase, Cottonwood Phase, and Birch Phase time periods are a long-time signature of Alaska Peninsula Pacific cultures.

Resources from 2800-4500 B.P. – Takli Birch Phase (USDOI, MMS, Alaska OCS Region, 1995:Figure III.C.5-3): No archaeological evidence has been found for the 1,000-year time period between the Cottonwood and Birch phases. Chipped-stone tools are found comparatively less often in the Birch Phase. This change does not lower the number of types of chipped-stone tools, however, and almost all earlier Takli Alder Phase types continue into the more recent Birch Phase. Chipped-stone-type tools actually increase in the Birch Phase. Square-shouldered- and unshouldered-slate bayonets are more common in the early Birch Phase (Clark, 1977, as cited by Mobley et al., 1990). Ground-slate knives increase in frequency and types in the late Birch Phase; and labrets are found in the higher, more recent level of the Takli Site, indicating their late appearance (Clark, 1977, as cited by Mobley et al., 1990).

Resources from 4500-6000 B.P. – Takli Alder Phase (USDOI, MMS, Alaska OCS Region, 1995:Figure III.C.5-3): Resources found at Clark's (1977) three Alder components (subparts of the Alder Phase) yielded fewer than 800 stone and bone artifacts. The Mobley et al. (1990) report explains the absence of some types (such as pecked-stone oil lamps) in contemporary Kodiak sites or the later Birch Phase by using the small sample size as an explanatory tool. According to that report, the large number of chipped-stone objects and the absence of ground-slate tools are the defining characteristics of Alder components (Mobley et al., 1990).

Nearly the whole sample of the bifacial chipped-stone objects in the Takli Alder Phase are present in Clark's (1979) Ocean Bay I assemblages. When making comparisons between Takli Alder and Ocean Bay I period from the Kodiak Archipelago, the two time periods look similar enough to suggest close cultural ties and regular communication across the waters between Katmai area and Kodiak Island (Clark, 1984; Workman, Lobdell, and Workman, 1980). Among the variances is a minor slate-sawing and chipping industry on Kodiak, and edge-polishing of adzes on the Alaska Peninsula. The remains of microblade manufacturing in both areas suggest that possibly the connection between these cultures goes back to Paleoarctic times (Mobley et al., 1990). On the other hand, the objects from the Bristol Bay side are not as similar as the microblades on Kodiak and the Alaska Peninsula. They appear to be linked to the Alaskan Interior and coastal zone (Mobley et al., 1990).

For research purposes, the importance of these resources surrounding the multiple-sale area is seen when the papers of de Laguna (1934), Dumond (1969a,b; 1971), Clark (1975a,b; 1977; 1979), and others do not totally agree on the migration routes of the people whose culture they are researching.

III.C.8.a(1)(b) Kodiak Archipelago Resources

People have lived on the Kodiak Archipelago for about 7,000 years, as determined from the many archaeological resources recorded. Apparently, it was more heavily populated along the coast and along the rivers and streams, where there was an abundant source of fish and wildlife.

Resources from 209-900 B.P. – Koniag Phase (USDOI, MMS, Alaska OCS Region, 1995:Figure III.C.5-3): Compared to the Kachemak stone-tool artifacts, the Koniag inventory is less varied. Wood labrets were abundant, and stone lamps are rarely found in assemblages from this time period. The paucity of chipped-stone tools in the previous period continues into the Koniag period, and the intricate art of carving bone objects is found less often in this period. The "splitting adze" style appeared probably because the people built larger, many-roomed houses. The pottery also was heavier and undecorated (Heizer, 1948-9, as cited in Mobley et al., 1990). Barbed harpoons, armor rods, slats, and even shield parts are present in some of the assemblages collected by archaeologists, showing that there was the necessity for the inhabitants to defend themselves from others during this time period as well as during the historic period.

Resources from 900-7000 B.P. – Kachemak, Ocean Bay II, and Ocean Bay I Phases (USDOI, MMS, Alaska OCS Region, 1995:Figure III.5-3.): There is a lack of any cultural remains for a period of about

1,400 years between the Koniag/Kachemak Phases. Despite this lack, Clark (1975a) thought the small Old Kiavik (Kachemak) assemblage was different enough from Ocean Bay II that it was unlikely the earlier (Ocean Bay I Phase) was a continuation of the later (Koniag/Kachemak Phase). Some of the distinctions are that slate-tool grinding and drilling methods were replaced by percussion (striking) methods and there was more variation in finish, intricacies, and ornamentation. The Kachemak objects are more varied, with more attention to finish, detail, and ornament. The use of ground-slate implements is an objective signature that sets Kodiak apart from the Alaska Peninsula, where chipped-stone tools frequently were used during the Ocean Bay time periods (Mobley et al., 1990).

III.C.8.a(1)(c) Kachemak Bay/Cook Inlet Resources

Resources from 200-2000 B.P.: During the Contact Period (the time when the European, English, and Russian people contacted the Native Alaskan people), other cultural traits were absorbed into the existing Native cultures; however, there was survival of traits and tools from the previous periods. Great changes in all of the Native cultures took place with the immigration of people from other cultures. Resources from this period reflect this change.

Ancestral Tanaina Athabaskans replaced Eskimo people (Workman, 1970). Abundant fire-cracked rock suggests the use of vapor-steam baths and suggests Tanaina and European relationships with Koniag occupations in the Kodiak Archipelago.

Kachemak III reveals a predominance of notched stones, stone lamps, stone hearths, semisubterranean houses, incised decorations, stone and shell beads, and other remains.

Resources from 2000-3300+ B.P. – Kachemak Sub-III, Kachemak II, and Kachemak I Phases: The Kachemak Sub-III Phase is thought to be a transitional period between Kachemak II and III, marked by an increase in artifact types and numbers. Kachemak II is known from Yukon Island, Chugachik Island, and the Merrill Site (Mobley et al., 1990).

In the Kachemak II Phase, semisubterranean houses constructed of stone, wood, and whalebone suggest Norton culture influence. Some elements may correlate with part of the Old Kiavik phase on Kodiak. The earliest dates for these resources are from the Kenai Peninsula outside Kachemak Bay.

In Kachemak I, there was a preference for chipped-stone and other implements associated with the Norton culture (Mobley et al., 1990).

III.C.8.a(2) Historic Resources

There were brief contacts between Captain Cook (1778) and the Cook Inlet Natives. There also was the first known awareness that other cultures existed in the land surrounding the sale area when Vitus Bering “discovered” Alaska in 1741 at Kayak Island. The first sustained influence on the peoples of Cook Inlet, however, was when the Shelikov-Golikov Company established a post at Three Saints Bay on Kodiak Island in 1784. Historic resources left from that era are abundant. In addition, Native villages, canneries, a fish hatchery, iceworks, saltworks, fishing cabins, fox farms, cattle ranches, cemeteries, churches, and military installations are just a few examples of the historic resources that have been found and what may exist on Kodiak Island, the Kenai Peninsula, and Cook Inlet. There is a scarcity of archaeological records of the Russian Period for the Pacific coast of the Alaska Peninsula, although a number of 18th century village sites have been identified from historic writings and maps. Some survey data are available in the records of the State Historic Preservation Office.

Villages on and across from Kodiak Island yielded many resources. Kukak was one of these villages visited and described in 1813. In 1912, the eruption of Mt. Katmai (Novarupta) formed the Katmai National Park and motivated the abandonment forever of the early villages of Katmai, Kaguyak, Ashivik, Swikshak, Kukak, Sutkum, and other villages on the eastern side of the Alaska Peninsula. Relocation to the Chignik area seemed to be the choice of those early residents. Katmai is the most important of the known early historic sites located on the eastern coast of the upper Alaska Peninsula. It was a large, year-round Koniag village before the arrival of the Russians and continued to be the largest village during the times of Russian occupation. As a fortified trading post of the Russian American Company, Katmai was the community on the eastern coast where Russians lived permanently. The old village was nearly completely buried by ash after the 1912 eruption, and high-rising, underground water levels have since made research on Katmai very difficult.

The village of Kanatak was occupied for a short time in the 1930's by Natives of the area who worked in nearby oil-exploration activities. They left about 20 years later (Mobley et al., 1990). Other oil-exploration sites may be present elsewhere on the eastern coast. Cook Inlet coastal settlement in the upper Alaska Peninsula region has been slow, consisting mostly of small hunting and fishing cabins and canneries.

III.C.8.b. Offshore Archaeological Resources

The following archaeological analysis was prepared for the offshore multiple sales for Cook Inlet, in accordance with the MMS Handbook for Archaeological Resource Protection (MMS 620.1-H, May 21, 1996). As required by the Handbook, separate analyses were completed for prehistoric resources (Prehistoric Resource Analysis) and historic resources (Shipwreck Update Analysis). The analyses are based on a review of all available information and are intended to identify those lease blocks within the sale area that may contain archaeological resources. These blocks, if leased, will require an archaeological report to be prepared as described in 30 CFR 250.194 prior to MMS approval of any lease activities.

The MMS archaeological resources protection program is conducted under the authority of the OCS Lands Act, as amended (43 U.S.C. § 1331 et seq.); the National Historic Preservation Act, as amended (16 U.S.C. § 470 et seq.); the National Environmental Policy Act (42 U.S.C. 4332 et seq.); Executive Order 11593; and the Department of the Interior, Solicitor's Opinion M36928, November 24, 1980.

III.C.8.b(1) Prehistoric Resource Analysis

The purpose of the prehistoric resource analysis is to provide an assessment of the potential for prehistoric archaeological resources to have occurred, have survived, and be recoverable within the proposed lease sale area. This analysis builds on the previous Prehistoric Resource Analysis completed for Cook Inlet Sale 149 (USDOI, MMS, Alaska OCS Region, 1995:Appendix F) and is based on a synthesis of existing data from relative sea level curves, high-resolution seismic-reflection surveys, bathymetric maps and sediment cores.

The procedures for the Prehistoric Resource Analysis outlined in Chapter 2.1.C of the Handbook are as follows:

- The prehistoric resource analysis shall integrate the geophysical/geological and archaeological information to determine the potential for prehistoric archaeological sites to occur and be preserved within the lease sale area. Preparation of the analysis shall be conducted in the following manner:
- Review relative sea-level data to determine the best estimate of relative sea level positions during the late Pleistocene and Holocene for the proposed lease sale area. Blocks that were not above sea level during times of potential human habitation will require no further prelease prehistoric resource analysis or postlease prehistoric resource reports.
- Examine the U.S. Geological Survey geology report and existing shallow hazards survey data for indications of significant landforms. If sufficient data exist to make a determination, those blocks that do not contain significant relict Pleistocene or Holocene landforms will require no further prelease prehistoric resource analysis or postlease prehistoric resource report. Those blocks that have insufficient information to make a determination or that are not excluded from further consideration based on a review of existing data shall require a prehistoric resource report.
- Examine geophysical and geological data for information regarding natural geologic processes that might have destroyed prehistoric resources within the lease sale area or rendered them unrecoverable. Examples of such forces and processes include, but are not limited to: (a) glacial scouring; (b) sea-ice gouging; (c) shore-face erosion; and (d) excessive sedimentation. An area will require no further prelease prehistoric resource analysis or postlease prehistoric resource report if existing data indicate that natural geological processes have occurred to an extent and depth that prehistoric resources would not have survived and/or are not recoverable.

III.C.8.b(1)(a) Existing Studies and Analyses

Onshore Quaternary glacial geology of the Cook Inlet area is among the most studied and documented in the world (Karlstrom, 1952, 1953, 1956, 1957, 1958, 1959, 1964; Dobrovolny and Miller, 1950; Miller and Dobrovolny, 1957, 1959; Krinsley, 1952, 1953; Reger, Combellick, and Brigham-Grette, 1995). Offshore studies in the lower Cook Inlet have been related primarily to marine geological processes and geological hazards analysis for oil and gas exploration (Bouma et al., 1977, 1978a, 1978b; Hein, Bouma, and Hampton, 1977; Hampton et al., 1978; Whitney et al., 1979, Whitney and Thurston, 1980; Thurston and Whitney, 1979; Whitney, Noonan, and Thurston, 1981). In the course of evaluating geologic hazards for Federal oil and gas lease sales in lower Cook Inlet, submerged glacial features were mapped (Thurston, 1985; and Thurston and Choromanski, 1995).

Archaeological assessments including summaries of previous work and updated analyses have been published by Dixon, Sharma, and Stoker (1979, 1986), Friedman and Schneider (1984), Mobley et al. (1990), and Haggarty et al. (1991). An in-house report summarizing the geomorphic processes pertaining to the occurrence and survivability of cultural resources was prepared for the Gulf of Alaska/Lower Cook Inlet Sale 114 (Miller, 1988).

Those new data that may serve to update the regional baseline study by Dixon, Stoker, and Sharma. (1986) and the analysis for the Cook Inlet Sale 149 (USDOI, MMS, Alaska OCS Region, 1995:Appendix F) have been incorporated into the following analyses for the multiple sale Cook Inlet area.

III.C.8.b(1)(b) Review of Relative Sea-Level Data

Dixon;, Sharma, and Stoker (1979) and Dixon, Stoker, and Sharma (1986) present evidence indicating that sea level was approximately 55 meters below present in the Cook Inlet area at approximately 12,700 B.P. (a date by which, according to existing archaeological data, prehistoric human populations had entered North America). We have used the 60-meter bathymetric contour (isobath) from the most recent protection diagrams (NO 4-6, NO 5-1, NO 5-2, NO 5-3, NO 5-4, NO 5-5 and NP 5-8) to approximate the location of the paleoshoreline at 12,700 B.P. Those lease blocks that fall seaward of the 60-meter isobath require no further evaluation for prehistoric archaeological resources.

III.C.8.b(1)(c) Identification of Relict Landforms

Existing data indicate the presence of some relict landforms within the Cook Inlet sale area that may have been favored site locations for prehistoric human populations in the area. In the absence of a complete high-resolution survey of the entire sale area, the presence of additional landforms that may be significant in identifying locations of preserved prehistoric archaeological sites cannot be ruled out.

Areas of lower Cook Inlet that display potentially significant landforms are found in the northern bathymetric plateau (Geomorphological Province I and II). These features include possible lake-shore, morainal-high-ground, and stream-shore environments. Moranial high-ground features and possible paleo-lake-shore environments are well preserved in the Kamishak Bay moraines on the west side of the inlet. For the most part, these deposits lie above the 60-meter isobath. The moraines of the eastern part of the northern plateau are deeper than -60 meters and are much less distinct in their form due to erosional modifications (USDOI, MMS, Alaska OCS Region, 1995:Figure F-7).

Buried channels in the central inlet may have been partially due to short glacial runoff streams that drained the glacial ice front. Ice fronts were very close to the ocean, as evidenced by many ice-rafted boulders in the southern inlet that were dropped from bergs that calved into the transgressing waters of Cook Inlet. These factors diminish the probability that prehistoric resources would be found preserved in association with these features.

III.C.8.b(1)(d) Review of Geological and Geophysical Data Pertinent to the Survival and Recovery of Prehistoric Archaeological Resources

The lower Cook Inlet is characterized by erosive processes that are not conducive to archaeological site preservation. These processes include strong bottom-density currents, high tidal range, winter ice cover, and scouring. Lack of protective Holocene sediments reduces the probability of archaeological site survival.

High-velocity tidal currents presently sweep the seafloor of lower Cook Inlet. Tidal ranges from 8.5 meters in the southern inlet to 11 meters at Anchorage generate rapid and complex tidal currents. At the Forelands, between upper and lower Cook Inlet, average current velocities are 5.6-7.4 kilometers per hour. In the central inlet, ebb and flow tidal currents with velocities nearing 2 kilometers per hour have been measured 10 meters off the seafloor (Whitney et al., 1979). Seafloor areas in water depths shallower than 60 meters are predominately covered by deposits characterized as lag gravels, sand ribbons, and sand-wave fields. All of these features formed during and after the Holocene rise in sea level to its present position. It is not likely that any prehistoric archaeological sites could have survived exposure to these high-energy processes necessary to produce the large bedforms and seafloor characteristics seen at the present seafloor in lower Cook Inlet. Those portions of the sale area outside these documented high-energy areas of lower Cook Inlet could contain preserved prehistoric site deposits.

III.C.8.b(1)(e) Lease Blocks with Prehistoric Archaeological Resource Potential

As a result of this analysis, 517 whole or partial blocks were analyzed to determine their potential for containing prehistoric archaeological resources (Map 1). All blocks that meet the following criteria are considered to have prehistoric site potential and will require an archeological report prior to MMS approving lease activities:

- Block lies shoreward of the 60 meter bathymetric contour;
- Block either contains known landforms favorable for prehistoric site locations or existing information is insufficient to evaluate the presence of such landforms;
- Block has sufficient holocene sediments to bury and preserve archaeological sites; and
- Block either shows no evidence of geologic processes that would have eroded and destroyed prehistoric sites or existing information is insufficient to evaluate the presence or extent of such geologic processes.

Based on the Prehistoric Resource Analysis of the Cook Inlet sale area, a total of 124 whole or partial lease blocks have been identified as meeting the above criteria. These blocks, which will require an archaeological report as specified in 30 CFR 250.194 are listed in Table III.C-15 and shown in Map 1.

III.C.8.b(2) Shipwreck Update Analysis

The purpose of the Shipwreck Update Analysis is to provide an assessment of the potential for locating historic shipwrecks within a proposed lease sale area. The procedures for the Shipwreck Update Analysis outlined in Chapter 2.2.B-F of the MMS Handbook for Archaeological Resource Protection are as follows:

- A regional baseline study or equivalent data should be used in the preparation of this document. All new data that may serve to update the regional baseline study will also be incorporated.
- Examine the available shipwreck data, and, where possible, ascertain the size, type, and construction of known shipwrecks in the proposed lease sale area.
- Determine the type of survey instruments, instrument sensitivity, and survey grid necessary to detect each known shipwreck in the proposed lease sale area.
- Examine geophysical/geological and physical oceanographic literature for information regarding natural processes or other physical factors that would influence preservation or destruction of a shipwreck.
- The shipwreck update analysis will identify areas with potential for historic resources and will identify specific lease blocks that require a historic resource report

III.C.8.b(2)(a) Existing Studies and Analyses

This analysis is based primarily on the shipwreck baseline study, *Shipwrecks of the Alaskan Shelf and Shore* completed in-house by the MMS Alaska Regional Office (Tornfelt and Burwell, 1992). The shipwreck database that was compiled for this study is continually updated by the MMS Alaska Regional Office as new data become available.

III.C.8.b(2)(b) Size, Type, and Construction of Known Shipwrecks within the Sale Area

The approximate locations of small shipwreck groups in the sale area are shown (Tornfelt and Burwell, 1992) and in the MMS computer program and maps. Of the 79 shipwrecks in Cook Inlet, 6 are in the multiple-sale area. There is not enough information on any of those six ships for them to be assigned to lease blocks. The other ships listed do not require archaeological review; however, they are listed because if found, each could be a hazard for drilling or become a source for small oil spills. The remaining ships (shown in Table III.C-16 and Map 1) are within the 3-mile limit or are outside the multiple-sale area. These "coastal" ships represent 92% of all the wrecks, and the offshore ships comprise 8%. The significance of these shipwrecks has not yet been fully assessed, and it is beyond the scope of this document to do so. However, for the purpose of this analysis, they all will be presumed to be historically significant.

III.C.8.b(2)(c) Survey Instruments, Instrument Sensitivity and Survey Grid Necessary to Detect Known Shipwrecks

The Alaska Region Notice to Lessee 00-A03 dated February 7, 2000 outlines the survey requirements for shipwrecks in the Alaska Region. The Notice to Lessee recommends that the lessee consult with appropriate MMS personnel before finalizing a survey strategy and plans. However, basic survey requirements are as follows:

- If it is determined that a magnetometer needs to be included in the survey package, a survey line spacing of 150 meters will be required.
- If a magnetometer is not required for the survey, the survey line spacing generally is 300 meters but needs to be such that side-scan sonar coverage is a minimum of 150% for the area surveyed.

III.C.8.b(2)(d) Natural Processes or Other Physical Factors that would Influence Preservation or Destruction of a Shipwreck

Seven volcanoes near the multiple-sale area have erupted in historic times (see Section III.A.1). Vessels wrecked prior to the eruption of Mt. Katmai in 1912 that may be lying on the seafloor in waters deeper than about 200 meters might have acquired some additional protection from further disintegration as a result of sedimentation occurring in the area after the eruption. Since 1912, the thickness of sediments accumulating in some areas of the Cook Inlet region ranged from about 8 centimeters in the northeastern part of the strait to 84 centimeters in the central part (Hampton, 1985). The thickness of the sediments generally increases in a southwesterly direction from about 10 centimeters in the northeast to about 60 centimeters in the area opposite Uganik Bay (Kodiak Island)—a distance of about 100 kilometers. The 1912 eruption deposited up to 3 meters of ash on Kodiak Island, which lies to the east of the volcano. The amount of ash from the eruption that accumulated on the seafloor east of Katmai was up to 20 centimeters thick in places (Hampton, 1985). Hampton (1983) noted: "Although not subjected to testing, the in situ density of ash is so great that normal gravity coring devices could not penetrate the layer. The relative density appears to be high and therefore the liquefaction potential is low."

The ash layer may provide some additional protection from further disintegration to the remains of wrecked vessels buried beneath it. The low liquefaction potential of the ash layer, as noted above, indicates it may be less susceptible to failure under cyclic-loading conditions than are the sediments in the overlying layer. The mean grain size of the surface sediments in the layer overlying the ash layer, in waters deeper than 200 meters, ranges from about 0.06 millimeters to about 0.004 millimeters (Hampton, 1983); these sediments largely consist of mixtures of silt and clay-size particles (Hampton, 1985). (The diameter of silt-size particles ranges from 0.004-0.062 millimeters and that of clay-size particles ranges from 0.00024-0.004 millimeters.) The coarsest fragments in the basal part of the ash layer were a few millimeters in diameter (Hampton, 1985). In addition, the particles in the ash layer would be more angular than are the flat particles of the clay minerals and the rounded particles of other minerals such as quartz or feldspars. The larger, angular particles require more energy to initiate movement than do the smaller, flatter, or rounder particles and thus would be more resistant to erosion. The accumulation of fine-grained (silt- and clay-size particles) sediments in waters deeper than 200 meters indicates the velocities of deep bottom currents are low (Roberts, 1993, pers. commun.). The earliest known shipwreck that might have been affected by a volcanic eruption in the sale area occurred in 1829.

III.C.8.b(2)(e) Lease Blocks with Historic Shipwreck Potential

Table III.C-16 lists the known historic shipwrecks within the Cook Inlet multiple-sale area and Map 1 shows the blocks that may contain historic archaeological resources. Based on the Historic Resource

Analysis of the Cook Inlet sale area, a total of 29 whole or partial lease blocks have been identified as having potential historic resources. These blocks, which will require an archaeological report as specified in 30 CFR 250.194 are listed in Table III.C-15 and shown in Map 1.

III.C.9. National and State Parks and Other Special Areas

Generally, the coast in the proposed Cook Inlet multiple sale area and the marine environment offshore contain beautiful shore and ocean features in addition to abundant animal life. Many people travel to this part of Alaska for just those features. The value of these resources is determined in part by these visitors. The major recreation and tourism resources for the proposed Cook Inlet multiple-sale area are shown in Map 1. Important national parks; national wildlife refuges; national preserves; national monuments; national natural landmarks; and State of Alaska recreation areas, parks, and similar places exist near the proposed Cook Inlet multiple-sale area.

III.C.9.a. National Resources

The following brief discussion of national parks, preserves, monuments, natural landmarks, and refuges describes some of the largest and most important resources related to tourism and recreation in the Cook Inlet multiple-sale area.

III.C.9.a(1) Katmai National Park and Preserve

The character of this park, 4,093,240 acres (1,660,000 hectares) in size, was created by the Mt. Katmai (Novarupta) eruption in 1912. It was not made a national park until all the other parks were created and finalized in the 1980's. The entire coast of Katmai National Park, including the offshore islands, is designated wilderness. It is a testimony to the power of nature to form a variety of scenes and geological changes with the eruption of a volcano. A huge mountain was transformed into a much lower terrain. The legislation establishing Katmai National Park and Preserve (P.L. 96-487) states it shall be "managed for the following purposes, among others: to protect habitats for, and populations of, fish and wildlife including, but not limited to, high concentrations of brown/grizzly bears and their denning areas; to maintain unimpaired water habitat for significant salmon populations; and to protect scenic, geological, cultural and recreational features." The significant topics, which could be impacted by the Proposed Action (Alternative I), are described in the appropriate subsections of Section III of this EIS, and analyses of impacts are in the appropriate subsections of Section IV. For example, brown bears are described in Section III.B.7.b, and potential impacts on brown bears are analyzed in Section IV.B.1.i.

III.C.9.a(2) Lake Clark National Park and Preserve

This national park encompasses more than 4,440,130 acres (1,800,000 hectares). A portion of the coast at Lake Clark National Park, Chinitna Bay, is designated wilderness. The park includes the glaciated mountain terrain in the extreme northern portion of the park on the divide between the Kuskokwim, Skwentna, and Chilligan rivers. Portions of the Stony, Telaquana, Mulchatna, Chilikadrotna, Little Mulchatna, and Kijik rivers, which generally include open, rolling, tundra-covered foothills with spruce/birch forests along the major stream courses, also are in the parkland. Included are two isolated forested lands west of Lake Clark, one near the Chulitna River and the other northwest of Hoknede Mountain. Most of the tundra and forest land within the Lower and Upper Tazimina Lake drainages, the Black Peak area, the Crescent Lake area, portions on either side of the Crescent River drainage, and the majority of the coastal forested lands along Cook Inlet between Chinitna and Tuxedni bays are primitive and ideally suited for backpacking. Much of the park provides habitat for caribou, wolves, moose, bears, birds, and fish. Dall sheep are found at higher elevations, particularly on the western side. Caribou migration routes run from the northern boundary of the park/preserve to the western boundary north and south of the Mulchatna River. Part of the Mulchatna caribou herd uses lands from north of the Mulchatna River to south of the Chilikadrotna River as calving grounds and the area west of the southwest shore of Lake Clark as winter range. Brown/grizzly bears are abundant along the coastal streams of Cook Inlet, where salmon spawn from June through September. The coast also is an important migratory bird route (USDOI, National Park Service, 1992, pers. commun.). The legislation establishing Lake Clark National Park and Preserve (P.L. 96-487) states they shall be "managed for the following purposes, among others: to protect the watershed necessary for perpetuation of the red salmon fishery in Bristol Bay; to maintain unimpaired the scenic beauty and quality of portions of the Alaska Range and the Aleutian Range, including active volcanoes, glaciers, wild rivers, lakes, waterfalls, and alpine meadows in their natural state; and to protect habitat for and populations of fish and wildlife including but not limited to caribou, Dall sheep, brown/grizzly bears, bald eagles, and peregrine falcons." The topics, which could be impacted by the Proposed Action, are described in the appropriate subsections of Section III, and analyses of impacts are in the appropriate subsections of Section IV. For example, brown bears are described in Section III.B.7.b, and potential impacts on brown bears are analyzed in Section IV.B.1.i.

Accurate visitor statistics for both the Katmai National Park and Lake Clark are somewhat unreliable because of the high mobility of tourists, multiple-entry points, the size of the parks, and the under-reporting of tourist activity by vendors. According to vendor records, the total number of clients served by vendors operating out of Katmai and Lake Clark Parks for the year 2000 were 20,281; for 2001 it was 19,721 (USDOI, National Park Service, 2002). Another measure of activity can be viewed on Tables III.C-17 and III.C-18. The tables list a 13-year record of commercial operators based in either Katmai or Lake Clark Parks. For both Katmai and Lake Clark parks, the number of commercial operators has fluctuated sharply through the years. For the Lake Clark unit, vendor numbers over the last 5 years have focused around 169 and 196 operators. Katmai vendor levels reached a high of 280 operators in 1997 and have declined steadily since. As shown on Tables III.C-17 and III.C-18, apart from air-taxi operations, vendors offering sport-fishing opportunities are most numerous followed by those offering flightseeing and guided day hiking.

III.C.9.a(3) Kenai National Wildlife Refuge

The Kenai National Wildlife Refuge was established as the Kenai National Moose Range in 1941 to protect moose habitat. The Alaska National Interest Lands Conservation Act altered the boundaries and purposes of the range and created the Kenai National Wildlife Refuge. The refuge covers nearly 2 million acres of the Kenai Peninsula. It is one of only two refuges in Alaska that are readily accessible by road and is situated only 3 hours from Anchorage, the largest city in the State. The refuge supports a rich diversity of habitats and species, with more than 200 species of amphibians, birds, and mammals using the refuge. Salmon spawn in refuge waters. Rainbow trout and Dolly Varden are important for subsistence and recreational fishing. The eastern third of the refuge lies within the Kenai Mountains; the remainder lies within the Kenai Lowlands, an area of low ridges, hills, and muskeg. The refuge contains thousands of lakes, the largest of which are Tustumena Lake (73,000 acres [29,543 hectares]) and Skilak Lake (25,000 acres [10,118 hectares]). The uniqueness of this area has been recognized by the designations of the Simons Research Natural Area and the Kenai Wilderness Area.

The refuge is notable for many reasons: the Harding Icefield, one of four major icecaps in the United States, lies within the boundaries of the refuge and Kenai Fjords National Park. The Kenai River and its watershed provide spawning and rearing habitat for salmon, which are important to the refuge ecosystem and the Cook Inlet salmon fishery. The area is renowned for recreational fishing for salmon, trout, and Dolly Varden. The Chickaloon watershed and estuary is the major waterfowl and shorebird staging area on the Peninsula and is the only estuary on the refuge. Lakes throughout the northern lowlands comprise a unique geologic feature and provide a variety of aquatic habitats for wildlife. The Swanson River and Swan Lake canoe routes provide refuge visitors the opportunity to experience a mix of habitats and wildlife. These canoe routes are the only nationally designated trails on refuges in Alaska. The Skilak Loop Area encompasses a variety of habitats, wildlife species, and scenic vistas. Because it is entirely road accessible, it has been recognized as a valuable area for environmental education and interpretation and wildlife-oriented recreation. The range of recreational services offered to refuge tourists and the number of commercial vendors offering these services are shown in Table III.C-19. Visitor days devoted to certain types of activities are listed in Table III.C-20.

The first significant oil field in Alaska was discovered on the Kenai National Wildlife Refuge. Oil and gas development activities continue on approximately 220,000 acres (89,000 hectares).

The relentless effects of ice, water, and vegetation over time have produced views of the highest order. The wide variety of landforms, habitats, fish and wildlife resources, and mix of human uses of these resources combine to produce an area unique in Alaska.

There are 1,315,809 acres (532,507 hectares) of congressionally designated wilderness within the refuge. The National Park Service has recommended an additional 192,021 acres (77,710 hectares) for wilderness designation.

III.C.9.a(4) Kodiak National Wildlife Refuge

Kodiak National Wildlife Refuge was established in 1941 to preserve habitats of brown bears and other wildlife. It encompasses about 1,900,000 acres (849,300 hectares) on Kodiak, Uganik, Afognak, and Ban islands. These islands, part of the Kodiak Archipelago, lie at the western edge of the Gulf of Alaska. About 245,000 acres (99,151 hectares) have been added to the refuge through purchase, donations, or easements during the past 10 years.

The refuge contains a variety of landscapes, including glacial valleys, tundra uplands, lakes, wetlands, sand and gravel beaches, salt flats, meadows, and rugged mountains. The refuge's 11 large lakes and many rivers are major spawning grounds for five species of salmon. Steelhead, rainbow trout, and Dolly Varden are found in refuge waters. The refuge supports a population of approximately 2,200 bears. It contains some of the best brown bear habitat in Alaska and supports some of the highest concentrations of brown bears in the world.

Besides brown bears, there are only five other native land mammals within the refuge: red fox; river otter; short-tailed weasel; little brown bat; and tundra vole. Several other species, including the Sitka black-tailed deer, elk, snowshoe hare, and beaver, have been introduced into the refuge. Whales, porpoises, sea otters, and sea lions are found in the bays adjacent to the refuge. More than 215 species of birds have been seen in the Kodiak Archipelago. At least 200 pairs of bald eagles nest on the refuge. An estimated 1.5 million seabirds winter in the refuge's bays, inlets, and shores. Waterfowl, numbering at least 150,000 birds, winter along the shoreline and on the refuge.

Salmon contribute to subsistence, recreational, and commercial fisheries. The average commercial salmon harvest in the Kodiak Archipelago between 1982-1996 was approximately 15.6 million fish with an approximate ex-vessel value to fishermen of $34.4 (range 14.0-94.0) million (approximately 31.5 million Euros at an exchange rate of .9190) . Refuge-based salmon stocks consisted of approximately 64% (9.9 million fish) of this total harvest and 68% ($23.5 million) of the ex-vessel value. There are 27 commercial setnet sites and 1 beach seine site located on refuge coastlines.

Hunting, fishing, and wildlife viewing are the primary recreational uses on the refuge. From 1994-1999, the average annual number of visitor use days was 9,545. The range of recreational services offered to refuge tourists and the number of commercial vendors offering these services are given in Table III.C-21. Visitor days devoted to certain types of activities are listed in Table III.C-22.

III.C.9.a(5) Alaska Maritime National Wildlife Refuge, Gulf of Alaska Unit

The Alaska Maritime National Wildlife Refuge is comprised of small islands, islets, rocks, reefs, spires, and headlands along the Alaska coast and extends from Forrester Island in Southeastern Alaska to Attu Island at the tip of the Aleutian Chain and almost to Barrow on the Arctic Ocean. That portion of the refuge of interest in this document is the Gulf of Alaska Unit, which includes islands and rocks in Cook Inlet and some tidelands, waters, and submerged lands around Kodiak and Afognak islands. It contains approximately 475,000 acres (192,000 hectares) and extends more than 800 miles from Kodiak Island in Southcentral Alaska to Forrester Island in southeastern Alaska. For the purposes of analysis in this EIS, Tuxedni Bay area of the refuge is of particular interest. Located offshore of the Lake Clark National Park and Preserve in the western Cook Inlet northwest of Homer, The Tuxedni Bay unit of the refuge primarily is composed of Chisik and Duck Island. Tuxedni Bay is the home of seabirds, bald eagles, and peregrine falcons. Homer is the location of the Alaska Maritime National Wildlife Refuge's headquarters and visitors center.

Primary marine fishes occurring in the Gulf of Alaska Unit include walleye pollock, capelin, sand lance, herring, sablefish, halibut, salmon, and Pacific cod. Important shellfish include shrimp and Dungeness, king, and tanner crab. About 2.5 million seabirds representing 23 species inhabit the Gulf of Alaska Unit. Lagoons, bays, and coastal waters provide most of the waterfowl habitat on or adjacent to this unit and are used primarily for wintering and staging areas.

Ducks commonly migrating through or wintering on the refuge include black scoters, surf scoters, white-winged scoters, greater scaup, bufflehead, and common goldeneye. Shorebird habitats are generally restricted by vertical sea cliffs and abrupt shorelines along most of the unit. Bald eagles are commonly observed throughout the refuge. Other raptors on the refuge include rough-legged hawks, marsh hawks, short-eared owls, and probably great-horned owls. Forty-four species of songbirds have been reported in this unit.

Steller sea lion rookeries and haulout sites are located on several islands in the unit. The Outer Island, Sugarloaf Island, and Marmot Island Rookeries provide critical breeding, pupping, rearing, and loafing habitat for sea lions. Other marine mammals found in waters of the Gulf of Alaska Unit include harbor seals, fur seals, gray and beluga whales, killer whales, and sea otters. The range of recreational services offered to refuge tourists and the number of commercial vendors offering these services are shown in Table III.C-23. Visitor days devoted to certain types of activities are listed in Table III.C-24.

III.C.9.a(6) Becharof National Wildlife Refuge

In 1978, the Becharof National Wildlife Monument was established to protect this area, most notably the unique brown bear denning islands in the Island Arm of Becharof Lake. In 1980, the Alaska National Interest Lands Conservation Act created the Becharof National Wildlife Refuge from this monument. Encompassing approximately 1,157,000 acres (468,237 hectares), the Becharof National Wildlife Refuge lies adjacent to and directly south of the Katmai National Park and Preserve. The 502,000-acre (203,000-hectare) Becharof Wilderness Area includes most of the Pacific Ocean coastline of the refuge. An additional 396,000 acres (160,261 hectares) have been proposed for wilderness designation.

The refuge provides habitat for about 200 species of resident and migratory wildlife. Numerous rivers on the refuge provide spawning and rearing habitat for five species of Pacific salmon. Massive runs of salmon fuel refuge ecosystems by enriching freshwater streams and lakes with nutrients from the ocean and providing food for wildlife. Salmon spawning on the refuge also are important to humans; they support subsistence users, recreational anglers, and the Bristol Bay commercial salmon fishery.

The refuge is notable for a number of reasons. It contains Becharof Lake, which at 300,000 acres (121,400 hectares), is the second-largest lake in Alaska. The lake and its drainage support one of the largest sockeye salmon runs in Bristol Bay. The Becharof ecosystem provides habitat for brown bear, moose, caribou, nesting waterfowl and songbirds, small mammals, and other species within a rich matrix of vegetation types. Significant paleontological resources, including a pliosaur, have been located in the fossil-rich uplands. The Mt. Peulik/Gas Rocks area is geologically significant, being one of Alaska’s most recent volcanically active sites. The 1977 eruption of the Ukinrek Maars received international attention. Colonies of cliff-nesting seabirds host tens of thousands of murres and thousands of kittiwakes in addition to scores of cormorants and puffins. These are the only murre colonies between the Barren and the Semidi islands, a distance of 250 miles (402 kilometers). The cliffs provide habitat for the seabirds to use the forage resources of the southwestern end of the Shelikof Strait. These colonies, and marine resources, were impacted by the 1989 *Exxon Valdez* oil spill.

The range of recreational services offered to refuge tourists and the number of commercial vendors offering these services are shown in Table III.C-25. Visitor days devoted to certain types of activities are listed in Table III.C-26.

III.C.9.a(7) Alaska Peninsula National Wildlife Refuge

The Alaska Peninsula National Wildlife Refuge was created by the Alaska National Interest Lands Conservation Act in 1980 and lies adjacent to and south of Becharof National Wildlife Refuge. The Ugashik and Chignik units of the refuge encompass about 2,648,100 acres (1,071,686 hectares) and are managed jointly with the Becharof Refuge. These units are separated by the Aniakchak National Monument and Preserve, a unit of the National Park Service.

The refuge provides habitat for about 200 species of resident and migratory wildlife. Marine mammals, seabirds, and waterfowl use the coastal areas. Bald eagles, hawks, falcons, and owls nest on the rock pinnacles and spires. Tundra lowlands are host to caribou, moose, brown bears, wolves, tundra swans, and waterfowl. Salmon, trout, char, and numerous other fish species are common in the waterways. Five species of Pacific salmon spawn in the streams and lakes of the refuge. Massive runs of salmon fuel refuge ecosystems by enriching freshwater streams and lakes with nutrients from the ocean and providing food for wildlife.

Salmon, which spawn on the refuge, are important to humans as well; they support subsistence users, recreational anglers, and the Bristol Bay commercial salmon fishery. The Alaska Peninsula and Becharof Refuges sustain nearly 1,500 local jobs and contribute $70 million in income annually to the local economy, nearly all through supporting the commercial fishery by providing salmon and rearing habitat (Goldsmith et al., 1998).

The refuge is notable for a number of reasons. It contains the culturally and economically important Ugashik Lakes. The area around Mother Goose Lake provides important habitat for moose and a number of bird species. Several volcanoes have been active in the recent past. Mt. Chiginagak last erupted in 1971 and continues to vent gases and steam. Mt. Veniaminof, a massive stratovolcano with a base 30 miles (48 kilometers) in diameter and a summit crater 20 miles (32 kilometers) in circumference, erupted from 1993 to 1995. Mt. Veniaminof has the most extensive crater glacier in the United States and the only known glacier on the continent with an active volcanic vent in its center. In 1967, the 800,000-acre (323,760-hectare) Mount Veniaminof National Natural Landmark was designated to recognize the unique qualities of the area. The Fish and Wildlife Service has recommended 659,000 acres (267,000 hectares) of the refuge for wilderness designation.

The Joint Federal-State Land Use Planning Commission listed Chiginagak and Veniaminof volcanoes, Castle Cape, and the Pacific Coast as one of the outstanding scenic complexes of Alaska. The Black Lake-Chignik Lake area harbors one of the densest seasonal concentrations of brown bears in North America. The tributaries of the Chignik and Alec rivers provide the best examples on the refuge of high concentrations of spawning sockeye salmon and the large number of brown bears they attract.

Portions of the refuge provide important habitat for the Northern Alaska Peninsula Caribou herd. Caribou are essential to the subsistence lifestyle followed by many local residents and have been an important resource for recreational hunters. The range of recreational services offered to refuge tourists and the number of commercial vendors offering these services are given in Table III.C-25. Visitor days devoted to certain types of activities are listed in Table III.C-27.

III.C.9.a(8) Aniakchak National Monument and Preserve

Aniakchak National Park and Preserve is locates approximately 400 miles (644 kilometers) southeast of Anchorage about halfway down the 500-mile (805-kilometer) long Alaska Peninsula. The Aniakchak Monument was established in 1978; the preserve was added in 1980. The total extent of the Monument and Preserve is approximately 603,000 acres. The Monument and Preserve is accessable only by air- or watercraft. There are no visitor facilities in the park, and it is virtually undeveloped. The park’s unique feature is the 6-mile wide and 2,000-foot deep Aniakchak Caldera. The caldera once was covered by a deep lake; however, a section of the crater wall collapsed. The ensuing massive flood created an opening in the caldera called “The Gates.” The Aniakchak River flows from the caldera, through The Gates to the Pacific Ocean. The river’s unique qualities were recognized by Congress, which established it as a National Wild and Scenic River. The Aniakchak Caldera’s most recent activity occurred in 1931. Since then, some vegetation has returned to the caldera as have brown bears and caribou. In addition to brown bears and caribou, the Monument and Preserve is home to populations of moose, wolves, eagles, and river otters. Sockeye salmon spawn within the caldera in Surprise Lake. The lake is the headwaters of the Aniakchak River. The park’s Pacific coast and offshore islands provides rugged habitat for seals, sea lions, sea otters and various waterfowl.

III.C.9.a(9) Kachemak Bay Estuarine Research Reserve

Kachemak Bay is the largest reserve in the NOAA Research Reserve System. The reserve is located approximately 150 miles (241 kilometers) south of Anchorage on the western coast of the Kenai Peninsula. It is 350,000 acres in size and received its designation in 1999. The reserve is one of the most productive, diverse, and intensively used estuaries in the state of Alaska. The local community pursued the designation of Kachemak Bay as a National Estuarine Research Reserve to preserve the lifestyle and economy of the region. The reserve was established to increase understanding of the bay and its resources. Kachemak Bay features extensive tidal mudflats, subtidal habitat, and upland forests. The bay is 24 miles (39 kilometers) wide at its mouth and approximately 36 miles (61 kilometers) long. The southern shore is comprised of the Kenai Mountains, containing several glaciers with direct drainage to Kachemak Bay.

The NOAA is in the process of building a headquarters/visitor center facility that will be shared with the Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge. A groundbreaking ceremony was held in 2000. The building will be ready for occupation in 2004. Current facilities include temporary office space and a research staging area. The reserve is managed by the Alaska Department of Fish and Game with assistance from a research and education advisory group.

III.C.9.a(10) Kenai Fjords National Park

The Kenai Fjords National Park is located approximately 100 air miles (160 kilometers) south of Anchorage. The park occupies the southeastern portion of the Kenai Peninsula in Southcentral Alaska. The park lies within the Kenai-Chugach Mountains and is characterized by rugged and difficult to access terrain. The park was established in 1980 by the Alaska National Interest Lands Act. It covers approximately 670,000 acres (247,150 hectares) of which, 68,000 acres (27,676 hectares) are non-Federal lands. The Park encompasses nearly 65% of the Harding Icefield in addition to fjords, islands, and peninsulas of the Kenai coast. Numerous valley glaciers flow outward from the icefield, some of which reach the sea. Along the coast, glaciers have cut deep bays into the rugged shoreline creating a series of fjords. Due to abundant rainfall, heavy vegetation covers the tops of cliffs that rise a hundred or more feet above the ocean. The coastal area has abundant aquatic life, including seals, sea otters, migrating whales, and large summer populations of cliff-dwelling seabirds. Salmon runs are abundant, and shellfish resources are easily found. In 2002, the National Park Service estimated total recreation visits to the park at approximately 252,000. Of that number, 121,000 were to Exit Glacier, and 79,000 were tour-boat visits to the Kenai Fjords Glaciers. The park's headquarters id located in Seward.

III.C.9.b. State Resources

The State resources related to tourism and recreation in the Cook Inlet multiple-sales area include the McNeil River State Game Sanctuary and the more accessible Kenai River area (which includes about 30 State recreation areas and historic sites). These and others are listed in Table III.C-28.

III.C.9.b(1) McNeil River State Game Sanctuary

The McNeil River Valley is a broad area of generally rolling lowlands, although some of the hilltops near the periphery of the sanctuary reach elevations of 3,000 feet (914 meters), or more. The McNeil River drains a number of lakes in the interior of the Alaska Peninsula and reaches lower Cook Inlet at the head of Kamishak Bay. The river is comparatively broad, shallow, and slow moving. It traverses a number of low, shallow falls. This, coupled with the fact that it provides access to interior lakes for anadromous fish, makes it an outstanding salmon river. Thus, it is an ideal river for brown bears to take advantage of the salmon runs, and the area probably has the highest concentration of brown bears in Alaska during the annual salmon run. Part of the sanctuary also is a known denning area for brown bears. The vegetation of the sanctuary is mainly tall brush along the lower reaches of the river valley, with stands of cottonwood also occurring. The uplands are dominated by heath and alpine meadow with some alpine tundra at higher elevations.

III.C.9.b(2) Captain Cook State Recreation Area

The Captain Cook State Recreation Area (3,620 acres) (1,465 hectares) is located at the end of Kenai Spur Road. Access to the area is available from mile 36 on the North Kenai Road, about 22 miles (35 kilometers) northeast of Kenai. The recreation area encompasses forests, lakes, rivers, and saltwater beaches; offers swimming and canoe landing; and is the terminal point for the Swanson River canoe trails, picnic areas, and camping. Sport fishing is available all year. Moose, bald eagles, waterfowl, and bears are commonly seen in the park. On the coast, the offshore oilrigs in Cook Inlet can be seen with the Alaska Range in the background. Rock hounds, beachcombers, and driftwood collectors are attracted to the beaches. Sanitary facilities and water are available.

III.C.9.b(3) Clam Gulch State Recreation Area

The Clam Gulch State Recreation Area is located at mile 117 on the Sterling Highway. This recreation area provides access to one of the most popular razor clamdigging beaches on Cook Inlet. A four-wheel drive road provides access to the beach for vehicles and pedestrians. Camping and picnicking facilities are available, as are sanitary facilities and drinking water.

III.C.9.b(4) Ninilchik State Recreation Area

The Ninilchik State Recreation Area (97.35 acres) (39.4 hectares) is located at mile 135 on the Sterling Highway, about 38 miles north of Homer. This recreation site offers excellent sightseeing. Mt. Redoubt lies directly across Cook Inlet from Ninilchik. A Russian Orthodox Church built in 1900 overlooks the picturesque Ninilchik village and can be viewed from the site. The site also offers good clamming and both commercial and sport fishing for salmon and halibut. Water and sanitary facilities are provided.

III.C.9.b(5) Deep Creek State Recreation Area

The Deep Creek State Recreation Area is located at mile 138 on the Sterling Highway. This recreation site offers excellent fishing for salmon and halibut, and digging for razor clams and beachcombing are prime attractions. Coal washed up on the beach is used for fuel by local residents and visitors. A boat-launching facility for small crafts is available, and sanitary facilities and drinking water are provided.

III.C.9.b(6) Stariski State Recreation Area

Stariski State Recreation Area (30.05 acres) (12.16 hectares) is located at mile 151 on the Sterling Highway, 20 miles north of Homer; this recreation site is on a high bluff overlooking Cook Inlet. The view is outstanding, and beluga whales are frequently seen in the inlet. Extensive mortality of spruce trees from the spruce bark beetle epidemic has resulted in the clearing of most of the spruce trees from this site. Sanitary facilities and water are available.

III.C.9.b(7) Anchor River State Recreation Area

Anchor River State Recreation Area is located at mile 157 on the Sterling Highway near Anchor Point (15 miles (24 kilometers) northwest of Homer). At the mouth of the Anchor River, this recreation area is a popular halibut and king and silver salmon fishing area, and steelhead trout are a primary attraction in the fall and winter. This site is one of the best areas in which to observe seaside and alpine floral vegetation. An abundance of bird and sea life, including whales, can be observed in this area. Sanitary facilities and drinking water are provided.

III.C.9.b(8) Kachemak Bay State Park and Wilderness Park

Kachemak Bay State Park and Wilderness Park is located 2 miles (3.2 kilometers) across the water southeast of Homer. Access is available from Homer by plane or boat. This minimally developed park contains 328,290 acres (133,858 hectares) of wild mountainous terrain and magnificent ocean shoreline. Boating, beachcombing, fishing, and clamming are outstanding in the tree-lined bays, coves, and fjords; harbor seals and Eskimo and Indian house pits dating back 2,000 years may be seen on Chugachik Island; glaciers fed by the Harding Icefield spill down over the Kenai Mountains; and one can hike the marked, 3-mile-long trail from Glacier Spit to Grewing Glacier. Approximately 75 miles (121 kilometers) of hiking trails are maintained in the park, with access to developed campsites. Six Public Use Cabins are available for use on a reservation system. A Ranger Station is located in Halibut Cove Lagoon and is the trailhead location for much of the hiking within the park. Numerous unnamed glaciers exist in this wilderness area. Kachemak Bay provides excellent fishing for halibut, salmon, shrimp, and Dungeness and tanner crabs. Leisure Lake provides excellent rainbow trout fishing. Bears, wolves, goats, moose, and an abundance of bird life can be seen in the park.

III.C.9.b(9) Kodiak Area

In the Kodiak Area, Ft. Abercrombie State Historic Park (182,720 acres) (73,946 hectares) is located at mile 4.0 on Rezanof Drive. Access is near Mill Bay Road about 3.5 miles north of Kodiak. Fort Abercrombie was a World War II military installation established in 1941 to defend the Naval Air Station on Kodiak Island. The park contains remnants of gun carriages, emplacement magazines, and other structures. Located on Miller Point on the northeasterly shore of Kodiak Island, Fort Abercrombie overlooks Mill Bay and Monashka Bay. It offers visitors spectacular views from steep rock cliffs and camping within densely wooded forests. It is the only developed State park on the island.

III.C.9.b(10) Pasagshak State Recreation Site

Pasagshak State Recreation Site (20.136 acres) (8.15 hectares) is located at mile 40 on the Pasagshak River Road. Access is available by a State-maintained gravel road near Pasagshak/Narrow Cape Road 40 miles (64 kilometers) south of Kodiak. Land along the Pasagshak riverfront is level, and vegetation is typical Kodiak grazing grassland. Upland portions rise abruptly into steep, low mountains. Views include the surrounding mountains, the Pasagshak River, and Pasagshak Bay. Its recreational value is primarily fishing. There are no developed camping or picnic facilities on site.

III.C.9.b(11) Critical Habitat Areas

There are four State critical habitat areas that potentially could be affected: Redoubt Bay, Kalgin Island, Clam Gulch, and Kachemak Bay. Each of these areas has critical habitat for various kinds of wildlife.

III.C.9.c. Kenai Peninsula Borough Area That Merits Special Attention: The Port Graham/Nanwalek Area

This Area Meriting Special Attention includes the river drainages, coastal lowlands, tidelands, and marine waters surrounding Nanwalek and Port Graham from Point Pogibshi on the north to Koyuktolik Bay on the south, extending inland to the 1,000-foot (300-meter) contour and offshore 1 mile (1.6 kilometers). Development within the Area Meriting Special Attention includes two communities, a dock, fish-processing plant, residences, and seasonal cabins that surround the coastline. Community sewage outfalls extend into the bay and Homer Electric Association power lines cross the bay near Port Graham. This Area Meriting Special Attention has outstanding scenic values and contains potential historic and archaeological sites. This area serves the subsistence activities of the residents of Port Graham and Nanwalek and also is used for sportfishing and possesses fisheries and timber resources. The Area Meriting Special Attention plan for the Port Graham/Nanwalek area should accommodate continued fish processing, vessel moorage, personal and commercial setnet fishing, and future timber transfer operations.

III.C.10. Coastal Zone Management

The Federal Coastal Zone Management Act and the Alaska Coastal Management Act were enacted in 1972 and 1977, respectively. Through these acts, development and land use in coastal areas are managed to provide a balance between the use of coastal areas and the protection of valuable coastal resources. Local coastal districts can develop coastal management programs and tailor Statewide standards to reflect the local situations. These coastal management programs are incorporated into the Alaska Coastal Management Program after they are approved by the Alaska Coastal Policy Council and the Secretary of the U.S. Department of Commerce through the Office of Ocean and Coastal Resource Management. After approval by the U.S. Department of Commerce, Federal agencies must ensure that their direct actions are consistent to the maximum extent practicable with the enforceable policies of the Coastal Management Program. To ensure such conformance, the MMS prepares a Federal consistency determination for OCS lease sales. Additionally, the State reviews certain OCS activities to determine whether those activities will be conducted in a manner consistent with the enforceable policies of its approved Coastal Management Program. This review is applicable to Federal licenses or permits issued for OCS-related activities and activities described in OCS plans that affect any land or water use or natural resource of the State's coastal zone.

Both coastal districts adjacent to the lease-sale area have approved coastal management programs. These districts are the Kodiak Island Borough and the Kenai Peninsula Borough (Figure III.C-26). The following paragraphs provide an overview of these district programs, their specific enforceable policies, and the Alaska Coastal Management Program. Kodiak Island Borough's Coastal Management Program was fully incorporated into the Alaska Coastal Management Program in 1984. Activities that could affect fish and fishing resources and the fishing industry are carefully regulated through the Borough's coastal management programs policies. In addition, the coastal management program contains policies that specifically address activities associated with oil and gas exploration and development (Kodiak Island Borough, 1984). The portion of the Bristol Bay Coastal Resource Service Area that abuts Shelikof Strait has been incorporated into the Kodiak Island Borough. Until the Kodiak Island Borough amends its coastal management program to include the western Shelikof area incorporated by the Borough, the enforceable policies of the Bristol Bay Coastal Resource Service Area Coastal Management Program are the enforceable policies for that portion of the Shelikof coast. The Bristol Bay Coastal Resource Service Area Coastal Management Program policies emphasize the protection of fish resources and the fishing industry. They also augment the 16 Statewide standards for siting energy-facilities policies that are related directly to oil and gas development (Bristol Bay Coastal Resource Service Area Board, 1987).

The Kenai Peninsula Borough Coastal Management Program was fully incorporated into the Coastal Management Program in 1990. Borough-wide policies are general and not intended to create a substantial change from the existing Statewide standards. More detailed planning is anticipated to occur through the use of special plans for "Areas that Merit Special Attention" (Kenai Peninsula Borough, 1990). The first of the Areas That Merit Special Attention plans, the Port Graham/Nanwalek Areas that Merit Special Attention, was approved by the Coastal Policy Council in October 1991 and incorporated into the Alaska Coastal Management Program in 1992.

The Lake and Peninsula Borough Coastal Management Program became effective on October 31, 1996, and has been incorporated into the Alaska Coastal Management Program. The Borough lies inland of the sale area boundaries; however, some of its enforceable policies may be applicable to OCS activities in Cook Inlet.

III.D. OIL AND GAS INFRASTRUCTURE

III.D.1. Pipelines and Production and Processing Facilities

The upper Cook Inlet and Kenai Peninsula have an association with the petroleum industry that dates back to the 1950's. The first discovery in the region took place onshore in 1957, when oil was discovered on the Kenai Peninsula from the Swanson River #1 well. Except for the Beaver Creek Unit, which began producing oil in 1972, all other oil-producing fields are located in State waters. At the height of oil production (1970), the Cook Inlet region produced 80 million barrels; by 1983, production had declined to 24.7 million barrels; and by 2001, production had declined to just under 10 million barrels annually. Producible quantities of natural gas were first discovered in 1959 in what is now the Kenai Gas Field (Map 18). Gas production in the Cook Inlet region did not begin until 1960. By 1983, annual natural gas production had reached 196.4 billion cubic feet (5.56 billion cubic meters). In 2001, Cook Inlet Region gas produced 276 billion cubic feet (7.816 billion cubic meters)from 14 fields; of this amount, 2.8 billion cubic feet (793 million cubic meters)were reinjected to maintain oil production (see Tables V-11, 12, and 13 for additional details).

There are 14 active offshore production platforms in Cook Inlet. An additional platform, the Osprey, will enter into production within the next 2-3 years. There are three onshore treatment facilities along the shores of the upper Cook Inlet and approximately 221 miles (356 kilometers) of undersea pipelines, 78 miles (126 kilometers) of oil pipeline, and 149 miles (240 kilometers) of gas pipeline. These facilities, in addition to onshore pipelines, are listed in Tables V-4, V-5, and V-12 and detailed on Map 18.

Existing Cook Inlet region crude oil production (offshore and onshore) is handled through the Trading Bay production facility (Map 18) and the Tesoro Refinery. Cook Inlet-produced gas is consumed by a variety of users: it is burned for electric power at Enstar's Beluga power-generation plant, transported to Anchorage for local usage, processed at the Phillips-Marathon liquefied natural gas plant, or processed by the Agrium U.S. Inc. chemical plant. The Phillips-Marathon and Agrium plants and the Tesoro refinery are located at Nikiski, Alaska, north of the city of Kenai. The Trading Bay facility pipelines its received crude oil production to the Drift River Terminal, which stores and loads at least 8.2 million barrels annually. Since 1996, all Drift River tanker loadings are transported to the Tesoro Nikiski refinery.

The Tesoro Refinery can process up to 80,000 barrels per day, although current production is estimated around 50,000 barrels per day. Recent refinery production has been augmented by North Slope oil tankered from Valdez. Almost all Tesoro's output is consumed within Alaska. A 70-mile (113-kilometer) products pipeline links the Nikiski refinery with the Tesoro fuel depot located at the Port of Anchorage. Tesoro's refined products include multigrades of gasoline, propane, Jet A fuel, diesel No. 2, diesel, jet fuel 4 (JP4), and No. 6 fuel oil.

The Phillips-Marathon liquefied natural gas plant was constructed in 1969 and liquefies 1 million tons (approximately 900,000 metric tons) of liquefied natural gas annually. It is the only natural gas liquefaction plant in the United States. Produced liquefied natural gas is shipped by tanker to Japan by 80,000-cubic-meter carriers on an average of once every 10 days (approximately 8.5 metric days).

The Agrium chemical plant can process gas to produce more than 1.1 million tons (1 million metric tons) of ammonia and a similar quantity of urea pills and granules (for fertilizer). Some of the produced urea is used in Alaska; the rest is shipped to the west coast of the United States in tankers and bulk freighters. Tables V-11, V-12, and V-13 provide additional information regarding oil and gas infrastructure in the affected area.

Material and equipment needed to develop any potential lower Cook Inlet facilities probably would be initially offloaded at Ted Stevens Anchorage International Airport or the Port of Anchorage, or barged from out of State to an offshore work site. Such items could be transported by the Sterling Highway to an appropriate site on the Kenai Peninsula or, if offloaded at the Port of Anchorage, transported by workboat or barge to site.

III.D.2. Air-Support Infrastructure

The proposed sale area is immediately served by two airfields: one at Kenai and the other at Homer. The Kenai airport has a single 150 foot by 7,575 foot (46 meter by 2,309 meter) runway that is equipped for night operations. The airfield has a control tower, some cargo facilities, and basic repair facilities. The Kenai airport sits on 1,200 acres (486 hectares). In 2001, the airport experienced 78,900 operations, of which 34,100 were air-taxi operations. There are 101 aircraft, including 8 helicopters based in the Kenai airport. The City of Kenai is served by scheduled passenger flights from Anchorage. The Homer airport sits on 1,040 acres (421 hectares) and has a single 150 foot by 6,701 foot (46 meter by 2,042 meter) runway. Although equipped for night operations, the field has no control tower and is not maintained between 10 p.m. and 8 a.m. Homer is served by scheduled passenger flights from Anchorage. In 2001, the airfield processed an estimated 35,100 flight operations, of which 20,700 were attributable to air taxis. There are 91 aircraft currently based at the Homer airfield, 3 of which are helicopters. Both fields could service midrange cargo aircraft such as C-130's in addition to smaller cargo and passenger jets (g.c.r. & Associates, 2002).

In addition, there are privately owned heliports and landing strips scattered on both sides of the Cook Inlet that could be used to provide support for onshore and offshore oil and gas development activities.

Southcentral Alaska's principal airport is Ted Stevens Anchorage International Airport. In 2001, 13 billion pounds of cargo were handled. The port serves as a sorting hub for both Federal Express and United Parcel Service. It has four cargo airparks with a total of more than 1.2 million square feet (112,000 square meters) for transient cargo parking. The airport has three major runways, ranging between 10,500 feet (3200 meters) and 11,500 feet (3205 meters) in length. In 2001, the airport processed 5.1 million passengers from 32 domestic and 8 international carrier gates (State of Alaska, Dept. of Transportation, 2002a).

III.D.3. Surface Transportation

The Cook Inlet Kenai Peninsula region is connected to Anchorage and the North American highway system by a single 224 mile (360 kilometer) highway. The route is divided into an 89 mile (143 kilometer) segment that is part of the Seward Highway and the Sterling Highway, which comprise the balance of the connection. The Seward Highway is approximately 127 miles (204 kilometers) long. It begins in Seward and terminates in Anchorage. At mile 89, the road has a turnoff into the beginning of the 135-mile (217-kilometer) long Sterling Highway. The Seward Highway has been designated a National Forest Scenic Byway, because it passes saltwater bays, ice-blue glaciers, and alpine valleys. The first 50 miles (80 kilometers) of the highway twist and turn along the base of the Chugach Mountains and the shore of Turnagain Arm. This segment of the Seward Highway has been under continuous repair and upgrading over the last 10 years. Shoulders have been widened, and three-lane segments have been added for passing. The highway is closed occasionally during the spring due to snow avalanches.

The Sterling Highway extends south past the City of Kenai, along the shore of Cook Inlet, and terminates at the Homer Spit. Should recoverable quantities of hydrocarbons be found in lower Cook Inlet and an onshore pipeline constructed, most of the activity would be along this highway. The Alaska Department of Transportation and Public Facilities has a 10-year improvement plan for the Sterling Highway and is now beginning the upgrade of the road north of the city of Kenai, between miles 45 and 60. The highway generally is in good condition. It is a two-lane highway with 12-foot- (3.7-meter-) wide lanes and 4-foot- (1.2-meter-) wide shoulders and few passing lanes. Weight restrictions are limited to 20,000 pounds (9,072 kilograms) for single-axle vehicles, 38,000 pounds (17,236 kilograms) for dual-axle vehicles, and 42,000 pounds (19,051 kilograms) for triple-axle vehicles (State of Alaska, Dept. of Transportation, 2002b).

Vehicle traffic levels for the various Sterling Highway segments vary substantially according to season. Reviewing monthly average traffic data for three Sterling Highway segments—one at the north end of the Sterling, one just east of the City of Kenai, and one in the south at Anchor Point—summer traffic levels may exceed three times those of winter. For the year 2000, monthly average daily traffic for the northern segment reached 7,000 vehicles in summer; in winter, only 2,000 vehicle passages were noted. For the Kenai segment, there were 12,000 summer and 5,700 winter passages; for the Anchor Point area, 4,300 vehicles were counted in the summer and 1,500 in the winter (State of Alaska, Dept. of Transportation, 2002b). This disparity is due not only to weather but also to summer recreational activities and tourism.

Because of the often-intense use of the Seward and Sterling highways during the summer, the Alaska Department of Transportation and Public Facilities limits the use of these highways by long combination trucks (dual-axle trailers) to weekdays only between June 15 and October 1 (State of Alaska, Dept. of Transportation, 2002b).

III.D.4. Marine Transportation

The Port of Anchorage is the dominant port facility in the Cook Inlet region.

Owned and operated by the City of Anchorage, the Port of Anchorage has a five-berth terminal that provides facilities for the movement of containerized freight, iron and steel products, wood products, cement, and bulk petroleum. In 2001, the Port moved close to 3 million tons (2.7 metric tons) of freight, of which 1.6 million tons (1.45 metric tons) were comprised of vans and trailers and 1.2 million tons (1.09 metric tons) were bulk petroleum products. Over the last decade, handled tonnage has varied between 2.3(2.08 metric tons) and 3.3 million tons (3 million metric tons); the majority of which has been containerized cargo (vans and trailers), with bulk petroleum products a consistent second in quantity (Municipality of Anchorage, 2002).

A 129-acre (52 hectare) industrial park adjoins the Port to the east. Additionally, there are 31.0 acres (12.5 hectares) for the staging and storage of transient marine cargo. The Port is served by a railroad system that links it with the Ports of Seward and Whittier and the Interior city of Fairbanks. The Port area also has served as a fabrication site for modules used for oil and gas development on the North Slope. In 2001, a sealift transported modules used on the Northstar Island, an artificial production island located in the Beaufort Sea off of Prudhoe Bay.

On the west side of Cook Inlet, the only marine facility of any note lies in Redoubt Bay off of the mouth of the Drift River. The Drift River facility lies direct across the Inlet from the City of Kenai. The terminal has 11 storage tanks with a total storage capacity of approximately 1.9 million barrels, virtually all of which are earmarked for crude oil. Crude oil produced from the Trading Bay and Granite Point oil pools are pipelined to the Drift River Terminal for storage and loading. The stored oil is pumped to the Christy Lee loading platform located 3 miles (4.8 kilometers) offshore. From there, the approximately 8.2 million barrels of annual crude oil production is transported to the Tesoro Nikiski refinery via a 46,000-deadweight ton (42,000-metric ton) tanker. The average load is 280,000 barrels, and approximately 30 trips occur annually.

On the east side of Cook Inlet, there are two port locations: the Port of Homer in Kachemak Bay and a collection of special-purpose docks located in and around the town of Nikiski. There are four principal docks in the Nikiski area: Crowley Maritime Services Rig Tenders Dock; Agrium U.S. Inc.'s Chemical Dock; the Phillips liquefied natural gas dock; and the Kenai Pipeline Company's Nikiski Terminal Warf. The rig-tenders dock is approximately 600 feet (182 meters) long and draws 10-14 feet (3-4.25 meters). The dock is used for the shipment of petroleum products but, more importantly, it serves the support boats that tend to the offshore production platforms. The dock is supported by a 20,000-square foot (1,858-square meter)warehouse, 7 acres (2.8 hectares) of open storage, and four pipelines that reach various petroleum-storage tanks. Although owned by Crowley, the dock is in part operated by Tesoro Petroleum. Agrium U.S. Inc.'s Chemical Dock serves a urea- and ammonia-production plant. The Agrium facility produces 2000 tons (1,956 metric tons) of anhydrous ammonia and 2,800 tons (2,738 metric tons) of dry, bulk urea daily. This production is loaded from a 1,135 foot (346 meter) wharf that draws 40 feet (12 meters) at mean lower low water. The Phillips-Marathon's Kenai liquefied natural gas dock is devoted entirely to the shipment of liquefied natural gas. The liquefied natural gas wharf is 1,500 feet (457 meters) long and draws 40 feet (12 meters)at mean lower low water. As mentioned previously, the liquefied natural gas facility loads 80,000 cubic meters every 10-20 days. The liquefied natural gas is transported to Japan for use by the Tokyo Electric Company. The Nikiski Terminal Wharf is owned by the Kenai Pipeline Company and operated by Tesoro Alaska Petroleum. The 1,310 foot (399 meter) wharf draws 42 feet (13 meters) of water at mean lower low water. The Nikiski wharf's primary use is shipping and receiving crude oil products. Tesoro Petroleum receives and ships bulk and refined petroleum products through the Nikiski wharf. Approximately 8.2 million barrels annually are shipped from the Drift River facility in 30 trips by Tesoro Alaska. An additional 7.3 million barrels are shipped annually from Valdez, Alaska (Noel, 2002, pers. commun.), accounting for 55-60 tanker offloadings at the Nikiski Terminal.

The Port of Homer in Kachemak Bay has a small boat harbor, a fisheries dock, and two general-service-docking facilities. The two general-service docks, the Pioneer Dock and the Deep Water Dock, jointly can provide up to five berthing spaces, the largest of which can accommodate a vessel up to 465 feet (142 meters). Both facilities draw up to 40 feet (12 meters) of water along their faces. The Pioneer Dock, with mooring dolphins, can moor a ship up to 800 feet (244 meters) along its face. The Pioneer Dock was built in 2002, and the Deep Water Dock was completed in 1990 (Marine Exchange of Alaska, 2002). Kachemak Bay has water depths that can accommodate any high-seas vessel. The bay serves as occasional anchorage for deep-draft vessels that are in scheduling lulls and, in the past, has provided anchorage for offshore exploration platforms.

For the year 2002, the number of dockings at Cook Inlet ports by ships in excess of 400 tons (363 metric tons) is estimated at 325, 75-90 of which would be oil and gas tankers. The single largest shipping component is the estimated 125 cargo and bulk carrier ships that would dock in Anchorage (Webb, 2002, pers. commun.). This figure excludes barge traffic and various noncargo capital ships.

Map 19 shows the approximate location of the major Cook Inlet ports of Homer, Nikiski, and Anchorage; the Drift River Terminal; and the Christy Lee Loading Facility. The map indicates the approximate route used by vessels transiting through Cook Inlet to the Port of Anchorage and other destinations. Vessels enroute to Cook Inlet ports and facilities such as Homer, Kenai/Nikiski, Anchorage, and Drift River pick up the pilot from the pilot boat south of Homer. Offshore platforms in upper Cook Inlet, as well as potential exploratory rigs located in the lower Cook Inlet, will be marked with a combination of flashing lights, fog signals, and retro-reflective material. These markings will depend on the platforms size, water depth, proximity to vessel routes, nature and amount of vessel traffic, and the effect of background lighting. The platforms form good radar targets, are well lit, and are used along with significant land features and aids to navigation to fix vessels' positions. Mariners are advised that obstructions in the area include platforms and are cautioned to avoid anchoring their vessels anywhere in the vicinity of the platforms. During the continuing program of establishing, changing, and discontinuing these structures, mariners are advised to exercise special caution to avoid collisions with these structures (United States Coast Pilot, 2002).

SECTION IV

ENVIRONMENTAL CONSEQUENCES

CONTENTS OF SECTION IV

IV. ENVIRONMENTAL CONSEQUENCES

Section IV - Environmental Consequences and Section III - Affected Environment constitute the scientific and analytical basis for the comparison of effects presented in Section III of this EIS. Section IV presents the following in detail:

- Direct and indirect effects of all the alternatives.
- Adverse environmental effects that cannot be avoided.
- Relationship between local short-term use of the environment and the maintenance and enhancement of long-term productivity.
- Irreversible and irretrievable commitment of resources that would be involved if any of the alternatives were implemented.

IV.A. BASIC ASSUMPTIONS FOR EFFECTS ANALYSIS

IV.A.1. Significance Thresholds

The Council on Environmental Quality National Environmental Policy Act (NEPA) regulations (40 Code of Federal Regulations (CFR) 1508.27) define the term "significantly" in terms of both context and intensity. "Context" considers the setting of the Proposed Action, what the affected resource might be, and whether the effect on this resource would be local or more regional in extent. "Intensity" considers the severity of the impact, taking into account such factors as whether the impact is beneficial or adverse; the uniqueness of the resource (for example, threatened or endangered species); the cumulative aspects of the impact; and whether Federal, State, or local laws may be violated. The analysis in this document uses terminology that is consistent with that definition. Impacts may be beneficial or adverse. Impacts are described in terms of frequency, duration, general scope, and/or size and intensity. The analysis in this EIS also considers whether the mitigation that is proposed as part of the project can reduce or eliminate all or part of the potential adverse effects.

- As directed by the Council on Environmental Quality NEPA regulations (40 CFR 1502.16), we discuss direct and indirect impacts (effects) and their significance on the previously listed physical, biological, and human social resources.

Our EIS impact analyses address the significance of the impacts on the resources considering such factors as the nature of the impact (for example, habitat disturbance or mortality), the spatial extent (local and regional), temporal and recovery times (years, generations), and the effects of mitigation (for example, implementation of the oil-spill-response plan). For example, for an endangered species, the analysis considers the possible effects of a large oil spill in terms of the following:

- lethal and sublethal effects;
- habitat affected;
- seasonality and spatial extent of the effect;
- what part of the population may be affected;
- oil-spill-cleanup mitigation;
- the likelihood of the oil contacting the species.

For impacts on water quality from construction disturbance, the analysis considers the following:

- the increases in suspended particles and turbidity relative to water-quality criteria;
- the temporal and spatial extent of the effect; and
- the contribution of this relative to naturally occurring turbidity.

Some impacts may be measurable, but their effects may be minimal and/or short-term in duration; therefore, they may not require avoidance or mitigation.

Adverse impacts that are reduced by mitigation below the "significance thresholds" that are incorporated into the project are considered "not significant."

For this EIS, we have defined a "significance threshold" for each resource as the level of effect that equals or exceeds the adverse changes indicated in the following impact situations:

- **Water Quality:** A regulated contaminant is discharged into the water column, and the resulting concentration outside a specified mixing zone is above the acute (toxic) State standard or Environmental Protection Agency criterion more than once in a 1-year period and averages more than the chronic State Standard or Environmental Protection Agency criterion over 25 square kilometers for a month. The spillage of crude or refined oil in which the total aqueous hydrocarbons in the water column exceeds 1.5 parts per million, the assumed acute (toxic) criteria, for more than 3 days over at least 10 square kilometers and 15 parts per billion, the assumed chronic criteria and the State of Alaska ambient-water-quality standard, for more than a month over 25 square kilometers. An increase in anthropogenic contaminants in regional sediments to levels which have resulted in adverse biological effects in 10% of tested organisms (Effects Range-Low; Long et al., 1995; Long, Field, and Macdonald, 1998). Violations would be caused by exceeding an effluent limit or creating an oil sheen. The accidental discharge of a small volume of crude or refined oil also might cause an adverse impact. However, an action of violation or accidental discharge of a small volume of crude or refined oil would not necessarily constitute a significant environmental impact as defined in 40 CFR 1508.27.
- **Air Quality:** Emissions cause an increase in pollutants over an area of at least a few tens of square kilometers that exceeds half the increase permitted under the Prevention of Significant Deterioration criteria or the National Ambient Air Quality Standards for nitrogen dioxide, sulfur dioxide, or particulate matter less than 10 microns in diameter; or exceeds half the increase permitted under the National Ambient Air Quality Standards for carbon monoxide or ozone.
- Lower Trophic-Level Organisms, Fisheries Resources, Essential Fish Habitat, Marine and Coastal Birds, **Nonendangered Marine Mammals, and Terrestrial Mammals:** A decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status. (See Section IV.B.1.h(1) and IV.B.1.i(1) regarding population-level effects.)
- **Threatened and Endangered Species:** An adverse impact that results in a decline in abundance and/or change in distribution requiring one or more generations for the indicated population to recover to its former status. (See Section IV.B.1.f(1)for more information regarding population-level effects.)
- **Economy**: Economic effects that would cause important and sweeping changes in the economic well-being of the residents or the area or region. Local employment is increased by 20% or more for at least 5 years.
- **Commercial Fishing**: Effects that would cause important and sweeping changes in the commercial fishing in the region. Commercial fishing in the region is diminished by 20% or more for at least 3 years, or 60% for 1 or more years.
- **Subsistence-Harvest Patterns:** One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1-2 years.
- **Sociocultural Systems:** Chronic disruption of sociocultural systems that occurs for a period of 2-5 years with a tendency toward the displacement of existing social patterns.
- **Recreation, Tourism, and Visual Resources:** A complete displacement or closure (5% of the peak season or approximately 7.5 days) or a partial closure (10% of the peak season or approximately 15 days) of a coastal-dependent, or coastal-enhanced recreation facility, area, or activity (other than fishing). Inclusion of a public scenic viewing area, such as a national or State park, within a 5-mile (8-kilometer) radius of an offshore energy structure.

- **Sport Fisheries:** Effects that would cause important and sweeping changes in the sport fisheries in the region. Sport fishing in the region is diminished by 20% or more for at least 3 years or 60% for 1 or more years.
- **Environmental Justice:** The significance threshold for Environmental Justice would be disproportionate, high adverse human health or environmental effects on minority or low-income populations. This threshold would be reached if one or more important subsistence resource becomes unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1-2 years; or chronic disruption of sociocultural systems occurs for a period of 2-5 years, with a tendency toward the displacement of existing social patterns. Tainting of subsistence foods from oil spills and contamination of subsistence foods from pollutants would contribute to potential adverse human health effects.
- **Archaeological Resources and Cultural Resources:** An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of unique, archaeological information.
- **National and State Parks and Other Special Areas:** The intrinsic values of the unit are affected for a period of 2-5 years.
- **Coastal Zone Management:** Any activities resulting in reasonably foreseeable effects that may conflict with land use plans and enforceable policies of applicable coastal management programs and cannot be addressed by the mitigation assumed for the Proposal or by existing regulatory requirements.

IV.A.2. Basic Assumptions for Effects Assessment by Alternative

Section II.B and Appendix B describe in detail the hypothetical scenario for exploration, development, and production used in the effects assessment. Under the hypothetical scenario, exploration activity following either or both lease sales would lead to discovery and development of a single field. Shallow hazards surveys and exploration drilling from a single platform would begin in 2006 and end in 2010. A single development platform and a 25-mile platform-to-shore oil pipeline would be installed in 2010-2011. Production of oil would start in 2011. Also under the scenario, a 25-mile gas pipeline would be constructed in 2022, and natural gas would be sent to shore starting in 2023. When production ceases in 2033, the field would have produced an estimated 140 million barrels of oil and 190 billion cubic feet of natural gas. Oil and gas sent to shore through the pipeline would be sent to existing onshore processing facilities on the Kenai Peninsula. The oil and gas produced would be consumed in Cook Inlet communities. As such, we foresee no tankering of Cook Inlet OCS production and that Cook Inlet OCS production will offset importation of petroleum by tanker from other sources, such as Trans-Alaskan Pipeline System crude oil.

Certain basic assumptions are common to the effects assessments for all the alternatives, except the No Lease Sale Alternative. A general overview of the Proposed Action (offering the entire sale area for leasing) shows that certain properties are common for the entire sale area, no matter where the action occurs or which alternative is chosen. The alternatives are analyzed on the basis of a field-development time profile called a scenario. The MMS traditionally bases the EIS scenarios on both geologic possibilities and on what is expected to be leased, discovered, developed, and produced in the sale area under consideration. Section II.B and Appendix B detail the scientific, economic, geologic, and other assumptions on which the exploration and development scenarios in this EIS are based. These topics include discussions of basic scenarios for exploration, development, production, and transportation. The location of any oil deposits is purely hypothetical, until oil is proven to be there by drilling (see Appendix B). While the scenario is reasonable and provides a basis for analyzing the effects, considerable uncertainty exists about where and when activities may take place, if they take place at all. In addition to uncertainty about the size and location of geologic resources, many other factors would influence where leasing, exploration, and development might take place. Such factors as the price of oil, the availability of high-grade onshore oil and gas leases, and company goals and perspectives about Alaska and offshore development would have tremendous effects on the level of participation in offshore oil and gas exploration and development in Cook Inlet.

While reading the effects assessment, please note that the MMS has developed the scenario to aid in the development of a complete and comprehensive analysis of the various possibilities that might arise from leasing, exploration, and development activities. As described in Section II.A.1, the alternatives in this EIS evaluate leasing within the Cook Inlet. The scenario developed by the MMS indicates our analytical assumption, based on professional judgment, is that exploration would result from each lease sale and would lead to the development of a single field.

The remainder of this section evaluates the potential effects of the Proposed Action and all the other alternatives. The information in this section is presented by resource and evaluates the effects of the Proposed Action (Alternative I) and the No Lease Sale Alternative (Alternative II), followed by an analysis of the differences between the Proposed Action and the Lower Kenai Peninsula Deferral (Alternative III) and the Barren Islands Deferral (Alternative IV). In many cases, the estimated effects of a specific alternative for a particular sale are identical or similar to those effects of the alternative for another sale. In such cases, rather than repeat the analysis, we reference the effect already described for another alternative and sale combination that would have the same effect. In this case, appropriate rationale will be included.

To help focus, we provide only the information that will help the reader and decisionmaker focus on the differences among the alternatives. Table II.B-2 compares the effects by alternative and sale.

Each analysis of effects in this EIS evaluates the following key resource topics that were identified during scoping:

- Water Quality
- Air Quality
- Lower Trophic-Level Organisms
- Fisheries Resources
- Essential Fish Habitat
- Endangered and Threatened Species
- Marine and Coastal Birds
- Nonendangered Marine Mammals
- Terrestrial Mammals
- Economy of Cook Inlet
- Commercial Fisheries
- Subsistence-Harvest Patterns
- Sociocultural Systems
- Recreation, Tourism, and Visual Resources
- Sports Fisheries
- Environmental Justice
- Archaeological and Cultural Resources
- National and State Parks and Other Special Areas
- Coastal Zone Management

As outlined in Section IV.A.3, the analysis of effects for each resource will be presented as effects from exploration and effects from development and production (routine operations including disturbance and discharges, large oil spills, large natural gas releases).

If leasing takes place, we can project that impacts that likely would occur from the following:

- noise from seismic surveys, aircraft, and marine support boats, and
- traffic from seismic-survey vessels and aircraft.

If exploration drilling takes place, the following impacts, in addition to the aforementioned seismic activities, could result:

- noise from siting and operation of the exploratory drilling rig;
- traffic for crew and supply vessels;
- discharge of well-drilling fluids and domestic wastewater generated from the exploration facility;
- solid-waste disposal from exploration wells (drilling muds and cuttings) and trash and debris from the human activities supporting exploration;
- gaseous emissions from offshore and onshore facilities and transportation vessels and aircraft; and

- physical emplacement, presence, and removal of exploration facilities.

If exploration leads to development and production, impacts likely could occur from the following:

- noise from construction of pipelines and production facilities;
- routine and recurring traffic associated with crew and supply activities;
- domestic wastewaters generated at the offshore facility (As discussed in Appendix B, Section C.1.a, the scenario assumes on-platform disposal wells will reinject drilling fluids, muds, cuttings, and produced waters generated from production wells.);
- trash and debris from production activities;
- gaseous emissions from production facilities, both onshore and offshore, and from transportation vessels and aircraft; and
- physical placement, presence, and removal of offshore production facilities, including platforms and pipelines to onshore common carrier pipelines.

We expect the activities could result in small oil spills, fuel spills, and natural gas releases. Other accidental activities could, but are not expected to, occur. For instance, large oil-spill accidents (greater or equal to 1,000 barrels from blowouts, production accidents, pipeline leaks, and fuel spills) also could occur. The reader and decisionmaker(s) should consider the low probability that an oil spill might occur when considering a spill and cleanup effects. Even though for analytical purposes we assume that an unlikely large oil spill occurs and provide information about the chance that an oil spill would contact a specific area or resource, the reader should remember that the most likely number of spills greater than or equal to 1,000 barrels occurring from the two lease sales is zero. Also, when reading our estimate of the effects of an oil spill, the reader should note that the EIS does not consider any reduction in effects that would result from required oil-spill-response activities. All exploration and production activities require an approved oil-spill-response plan and, if an oil spill occurred, oil-containment and -cleanup activities would begin within hours or minutes of the detection of a spill.

Sections IV.C through IV.F are common to all alternatives for Sales 191 and 199 and are analyzed by resource category. These sections include the following topics:

- Unavoidable Adverse Effects
- Relationship Between Local-Short-Term Uses and Maintenance and Enhancement of Long-Term Productivity
- Irreversible and Irretrievable Commitment of Resources
- Effects of a Low-Probability, High-Effects, Very Large Oil-Spill Event

IV.A.3. Disturbances

Activities such as oil and gas exploration, development, and production could disturb the ecosystems in which they are taking place. Unlike oil spills, which are probabilistic in natural and unlikely to occur, disturbances are expected to occur if postsale activities take place. In general, disturbance effects would result from industrial activities, noise, and habitat alteration.

IV.A.3.a. Industrial Activities

Disturbances to the environment would occur from both exploration and, if an economic field is discovered, development and production activities assuming a sale occurs, some tracts are leased, and industrial activities commence. Exploration includes seismic activities and support and logistic activities. If exploration results in a commercial discovery, then during the construction and operation phases, seismic activities, production platform and drilling activities, and support and logistic activities would occur.

Under our hypothetical scenario, activities such as seismic surveys would take place in the fall. Construction of production and transportation facilities could be completed in 1-2 years. Once construction is complete, production facility operations would occur year-round, over a 22-year period. The analyses in Section IV.B.1 describe and evaluate the effects of these activities on resources in the multiple-sale area.

Some of the aforementioned activities generate noise (seismic and drilling activities), habitat alterations (construction of platforms and pipelines), and discharges to both the air and water.

IV.A.3.b. Noise

Noise generated by industrial activities can come from a variety of sources, such as transportation, general machinery use, construction, seismic surveys, and human activity. Noise, whether carried through the air or under water, may cause some species to alter their feeding routines, movement, and reproductive cycles. Most specifically, concerns about noise have been raised regarding marine and terrestrial mammals and marine birds, as well as Native Alaskan subsistence activities affected by these mammals and birds.

IV.A.3.c. Habitat Alteration

Habitat alteration can be viewed as a change or changes in the environment in which plants, animals, and humans exist. Habitat alteration can be caused by such activities as construction, new types of infrastructure, alteration of stream flow, influx of different cultural groups, and an increase in available jobs. All of the resources discussed in this EIS could be affected through habitat alteration. An alteration to the habitat of the marine mammals, birds, and other marine life could significantly alter the cultural resources and quality of life of the Native Alaskan people.

IV.A.3.d. Discharges to the Marine Environment

Should there be a discovery and development of oil resources resulting from Sales 191, 199, or both, the related construction of infrastructure locally could disturb the water quality of some of the affected area. Discharges include well-drilling fluids generated from the exploration facility (under the hypothetical scenario, as explained in Appendix B, these fluids would be reinjected using disposal wells at the platform for development and production) and domestic wastewater generated from the exploration facility or production platform.

IV.A.3.e. Discharges to the Air

Effects on air quality would come from industrial emissions related to vessel traffic, construction machinery, compressors, generators, and various types of engines. Other effects on air quality could come from evaporation of spilled oil into the atmosphere or in situ burning of hydrocarbons, in the unlikely event of an oil spill. Because disturbances and noise do not cause air-quality impacts, they are discussed no further.

IV.A.4. Oil Spills

A major concern we heard during the scoping process was the potential effects of oil spills. This section summarizes the oil-spill information and assumptions we use for purposes of analysis. Information on how the analysis and assumptions were derived is presented in Appendix A.

The EIS oil-spill analysis considers three spill-size categories: (1) small spills, those less than 1,000 barrels; (2) large spills, those greater than or equal to 1,000 barrels; and (3) very large spills, those greater than or equal to 120,000 barrels. The oil-spill-trajectory model addresses the movement of spills greater than or equal to 1,000 barrels. The oil-spill-trajectory model results are appropriate only for “large” spills greater than or equal to 1,000 barrels. Small spills are analyzed without the use of the oil-spill-trajectory model.

IV.A.4.a. Large Oil Spills

We define large oil spills as greater than or equal to 1,000 barrels. Large oil spills are divided into two spill categories depending on where they occur; offshore or onshore. Offshore spills are analyzed with the use of an oil-spill-trajectory model and onshore are not. For purposes of analysis, we will assume one large offshore or onshore spill occurs anywhere from Alternative I for Sales 191, 199, or their alternatives. This "what-if" analysis of oil spills addresses whether such spills could cause serious environmental impact. The analysis of a large spill represents the range of effects that might occur from a range of offshore or onshore spill sizes from Alternative I for Sales 191 and 199 or their alternatives.

These following sections summarize the assumptions we use to analyze large oil spills for each alternative. The section locations for the analyses of small and very large spills are shown in Section IV.A.4.c - Locations of Oil-Spill Analyses.

The assumptions about large oil spills are a mixture of project-specific information, modeling results, statistical analysis, and professional judgment. For details on any of these points, please read Appendix A. We believe Appendix A is the basis for understanding the discussions about the effects of large oil spills on resources of concern in Section IV.C.

IV.A.4.a.(1) Large Offshore Oil Spills

Table IV.A-1 shows that the large offshore spill size we assume for purposes of analysis is 1,500 or 4,600 barrels for crude and 1,500 barrels for diesel oil. The offshore spills are broken out as follows:

- production facility (including storage tanks): 1,500 barrels
- offshore pipeline: 4,600 barrels

For further information on how we derive the information in Table IV.A-1, please read Appendix A.

In terms of timing, a large spill from Alternative I for Sales 191, 199, or their alternatives could happen at any time during the year. We assume that the production facility would not retain any oil. We assume that, depending on the time of year, a spill would reach the following environments:

- production facility and then the water and/or ice
- open water
- broken ice
- on top of or broken ice
- shoreline
- shorefast ice or snow

The analysis of a large offshore spill examines the weathering of oil, assuming the oil chemistry will be similar to that of Cook Inlet crude oil. The spill size is 1,500 or 4,600 barrels. We simulate two general scenarios, one in which the oil spills into open water during summer or winter and one in which the oil spills into 50% ice cover. We assume open water is January through December in some parts of the planning area, and a winter spill into ice is from December to February. For open water and broken ice, we model the weathering of the 1,500- or 4,600-barrel spills as if they are instantaneous spills. We report the weathering results at the end of 1, 3, 10, and 30 days.

In our analysis of offshore spills, we assume the following fate of the crude oil without cleanup. Figure IV.A-1 show the percent of crude oil evaporated, dispersed, and remaining. In the following, we summarize the results we assume for the fate and behavior of Cook Inlet crude oil and diesel oil in our analysis of the effects of oil on environmental and social resources. After 30 days in open water or broken ice:

- 33-36% evaporates,
- 13-62% disperses, and
- 5-52% remains.

We base the analysis of effects from large offshore oil spills on the following assumptions:

- The spill size is either 1,500 or 4,600 barrels.
- All the oil reaches the environment; the production facility retains no oil.
- The spill starts at the production facility or along the offshore pipeline.

- There is no cleanup or containment.
- The spill could occur at any time of the year.
- The spill weathering is as we show in Figure IV.A-1.
- The spill area varies over time, as we show in Tables A.1-3 through A.1-6 and is calculated from Ford (1985).
- The time and chance of contact from an oil spill are calculated from an oil-spill-trajectory model (Appendix A, Tables A.2-1 through A.2-30).
- The chance of contact is analyzed from the location where it is highest when determining effects.
- The overall chance of one ore more oil spills occurring and contacting is estimated from an oil-spill-risk analysis model (Appendix A. Tables A.2-31 through A.2-33).

The Chance of a Large Offshore Spill Occurring: After we analyze the effects of a large offshore oil spill, we consider the chance of one or more large oil spills occurring. Even though the chance of one or more spills occurring and entering offshore waters is 19%, we analyze the consequences of an oil spill because it is a significant concern to stakeholders. The MMS recognizes that multiple stakeholders have different interests and different analytical perspectives that shape the way they think about spill occurrence and identify a preferred policy response. For some stakeholders, a 19% chance of a large spill over the life of the field may be low and yet for others, it is high.

IV.A.4.a.(2) Large Onshore Oil Spills

Table IV.A-1 shows that the large onshore spill size we assume for purposes of analysis is 2,500 barrels from an onshore pipeline:

We base the analysis of effects from large offshore oil spills on the following assumptions:

- The spill size is 2,500 barrels (based on historic spill sizes, see Appendix A).
- All the oil reaches the environment.
- The spill starts along the onshore pipeline.
- There is no cleanup or containment.
- The spill could occur at any time of the year.
- Evaporation is the main weathering factor; we assume no dispersion.
- After 30 days 33-36% evaporates.

The Chance of a Large Onshore Spill Occurring: After we analyze the effects of a large onshore oil spill, we consider the chance of one or more large oil spills occurring. Even though the chance of one or more spills occurring is approximately 1.6%, we analyze the consequences of an oil spill because it is a significant concern to stakeholders.

IV.A.4.b. Small Spills

We define small spills as less than 1,000 barrels. From our initial assessment of Cook Inlet spill records from 1987-2001, we find small spill rates are similar in magnitude to OCS small spill rates. For purposes of analysis, we use the OCS rates estimated by Anderson and LaBelle (2000), because the records are better validated and the volume of production makes it statistically meaningful. For purposes of analysis, we assume the following small spills over the production life of the Cook Inlet multiple-sale area. This information is derived from Appendix A, Section E - Small Spills. For further information on the derivation of these assumptions, please see Appendix A.

Category	Number of Spills	Assumed Size (barrels)
0-1 barrel	470	0.07
1.1-9.9 barrels	11	2.8
10-49.9 barrels	2	17.8
50-499.9 barrels	1	87.0
500-999.9 barrels	0	643.0

IV.A.4.c. Locations of Oil-Spill Analyses

Following are section locations for the analysis of oil spills and their effects throughout this document:

- Section IV.B.1. Alternative I – Proposed Action: analysis of the effects of small and large oil spills from Alternative I for Sales 191 and 199.
- Section IV.B.2. Alternative II – No Lease Sale: assumes no spill occurs, because no action occurs.
- Sections IV.B.3 and IV.B.4. Alternatives III and IV – Lower Kenai Peninsula and Barren Islands Deferrals: analysis of the effects of small and large oils spills from Alternatives III and IV for Sales 191 and 199.
- Section IV.F. Low Probability, Very Large Oil Spill: analysis of the effects of very low-probability, very large oil spills.
- Section V.C. Cumulative Effects: analysis of cumulative effects by resource.
- Appendix A – Oil-Spill-Risk Analysis: supporting documentation for the assumptions we use in the oil-spill analysis in this EIS.

For more information on the analysis of oil spills, see Appendix A of this EIS and Johnson, Marshall, and Lear (2002) *Oil Spill Risk Analysis: Cook Inlet Multisale*.

IV.A.5. Spill Prevention and Response

This section describes oil-spill-response plans, agency involvement and reporting, and cleanup procedures.

IV.A.5.a. Oil-Spill-Response Plans

Each permittee operating offshore in the Cook Inlet is required to have an oil-spill-response plan with trained personnel and cleanup equipment and supplies at each activity site to meet Federal and State regulations. The term “activity site” refers to an exploration site, drilling site, or production site, in addition to the ancillary facilities of such sites. Federal regulations governing MMS operations related to offshore oil and gas activities are found in 30 CFR 250.300 and 30 CFR 254. These regulations address the prevention and control of oil spills and releases. Regulations 40 CFR 110, 112, and 300 address responses to spills or releases of oil and gas. Spill-response requirements would be thoroughly addressed when and if parcels are leased. Regarding oil-spill response, for example, an Application for Permit to Drill would be evaluated for (1) blowout-prevention equipment and (2) the size of the containment and recovery equipment in relation to the potential blowout volume. However, the conditions of such evaluations are site specific. In addition, certain State regulations may apply to oil-spill-response plans, as listed in 18 Alaska Administrative Code (AAC) 75; these regulations are administered by the State of Alaska, Department of Environmental Conservation.

An oil-spill-response plan does the following:

- includes response-action plans,
- identifies worst-case spill volumes,
- provides a list of contacts for State and Federal agencies that require notification in the event of a spill,
- identifies oil-spill-response organizations that provide support in the event of a spill,
- identifies other private companies that can be called on for further information or assistance, and
- inventories spill-response equipment.

IV.A.5.b. Agency Involvement and Reporting

Federal offshore lease operators have environmental obligations, as described in MMS regulations contained in 30 CFR 254 - *Oil Spill Response Requirements for Facilities Located Seaward of the Coast Line*.

By congressional action, the MMS is delegated the authority to ensure that wells drilled on Federal offshore lands are done so in a controlled manner. The MMS has the authority to cite the operator and bring civil and/or criminal charges for failure to comply with Federal regulations. If there is a spill or release of petroleum fluids or chemicals used in the petroleum industry on the lease, unit, or participating area, the MMS has the authority to cite the operator. Cleanup of the site will occur under the direction of the Federal and State On-Scene Coordinators. The Federal On-Scene Coordinators are the U.S. Coast Guard for coastal zone spills and the Environmental Protection Agency for land-based spills; the Alaska Department of Environmental Conservation is the State On-Scene Coordinator for spills impacting State lands and waters.

The MMS requires that oil spills greater than 1 barrel be reported to their authorized officer within 24 hours of the event. The MMS monitors the work of the lessee or operator to ensure that all personnel and equipment cited in the spill plan are available for response efforts and spills are appropriately cleaned up in accordance with all applicable laws and regulations.

In Alaska, the *Unified Plan for Preparedness to Oil Discharges and Hazardous Substance Release*, developed by the Environmental Protection Agency and U.S. Coast Guard with the Alaska Department of Environmental Conservation, identifies the governmental response network within the State of Alaska. The Unified Plan is augmented further with regional subarea contingency plans that are specific to the areas of operation, such as Cook Inlet. The plans identify response resources located within the area and identify environmentally sensitive areas in the geographic region. The Department of the Interior is a member of the Alaska Regional Response Team and has adopted the Unified Plan. The intent of the applicable laws and regulations is to prevent, as much as possible, hazardous materials and oil from entering the water and to ensure the rapid removal of these substances from areas where there is a danger of contaminating water. The Federal and State On-Scene Coordinators, in coordination with the surface-land managers, monitor and document the operator's actions and determine when the cleanup is satisfactory. On average, spill-response efforts result in recovery of approximately 10-20% of the oil released to the ocean environment.

IV.A.5.c. Spill Cleanup

The location of a spill and the season determines how much will be recovered. For the 3-barrel crude spills that contact land or solid ice, the cleanup rate can be nearly 100%. Free product can be removed with skimmers and sorbent materials, and any contaminated soil or ice can be excavated and removed from the environment for disposal. For the same small spills contacting open water, recovery rates drop to about 10-20%. To effectively remove a spilled product from the ocean surface, the responder must be able to concentrate enough of the spilled material using booms or ice to allow for recovery. Small spills are difficult to concentrate in sufficient quantity for efficient skimmer collection.

Effective recovery of small, refined-product spills (up to 0.7 barrel) also depends on where the spill occurs. Spills occurring on land or solid ice will be cleaned up almost completely. The spills can be wiped or skimmed up, and contaminated soil or ice can be excavated and disposed of properly. These same spills occurring in an open-water environment most likely would not be cleaned up. For such small-size spills, it is extremely difficult to collect a sufficient concentration to permit recovery by skimmers or sorbent materials.

Another method to clean up oil spills is in situ burning of oil, which involves burning the spilled oil on whatever surface it is on—ice, water, or soil. The burning can remove in excess of 90% of oil from the aquatic environment. The residual material is then collected from the ocean surface and returned to the shore for appropriate disposal. Preapproval for in situ burning has been granted for the marine environment by the MMS. The Federal On-Scene Coordinator will make the decision, in coordination with the State

On-Scene Coordinator, on whether to initiate an in situ burn. Burning can be conducted only when wind conditions are such that the smoke plume is carried away from communities.

To conduct an in situ burn, the oil must be collected and concentrated to a sufficient thickness to permit ignition and sustain burning. For in situ burning to be the most successful, burning operations need to be initiated as soon as possible, usually within the first 2-3 days of the spill. Once the crude oil begins to weather and lose the light volatile fractions, it becomes more difficult to ignite. Also, as the oil sits on the ocean surface, more water is incorporated into the oil, which causes an emulsion and further reduces the ability to initiate and sustain a burn. Emulsions containing more than 70% water generally will not burn. The application of emulsion breakers can reduce water content of the oil/water emulsion and increase the amount of oil that can be removed by burning.

Oil dispersants also are another nonmechanical spill-response method available for use in Cook Inlet. Dispersants are chemical products that are designed to increase the natural dispersion, evaporation, and biodegradation of spilled oils. Dispersants are best used when sea conditions are rough, because this aids in mixing the dispersant in the oil to increase dispersion. A problem associated with dispersant use is the potential toxicity of the products themselves as well as the dispersed oil. There is extensive debate regarding the effectiveness of dispersants on actual spills in cold water. The MMS, the Coast Guard, and industry have initiated additional research to better define dispersant effectiveness in cold waters and when and where it should be used.

Dispersant use must be approved by the Federal On-Scene Coordinator prior to application to the oil. The Alaska Regional Response Team has published the *Oil Dispersant Guidelines for Alaska* to help the responsible party and the On-Scene Coordinator evaluate the benefits and drawbacks of using dispersants. Guidance specific to dispersant use in Cook Inlet is published in the *Cook Inlet Subarea Contingency Plan for Oil and Hazardous Substance Spills and Releases*. The Plan provides general-use criteria that classify coastal waters into three zones based on physical parameters, such as bathymetry and currents, and biological parameters, such as sensitive habitats, nearshore human use, and time required to respond. Dispersant use in the nearshore environment is not recommended because of the potential risk to sensitive habitats and resources present in those areas.

IV.A.6. Accidential Gas Releases from OCS Production Facilities

Accidental releases of natural gas from OCS production facilities are rare. There are approximately 4,000 platforms in the Gulf of Mexico and 23 off the coast of California. These platforms have approximately 14,000 producing wells. Since January 1995, there have been 10 instances of loss of well control on production wells in the Gulf of Mexico and 1 instance in the Pacific Ocean. Four of the Gulf of Mexico incidents and the Pacific incident lasted a few minutes or less. Four of the incidents lasted 2 days or less. Two of the Gulf of Mexico incidents were of longer duration. One lasted 11 days and caught fire before it could be brought under control. The other incident occurred on an unmanned facility and involved a low-pressure gas well that leaked for 33 days before it was brought under control. The regulations covering well workover, recompletion, and abandonment activities require safety systems designed to prevent the release of hydrocarbons. In addition to these releases from production wells, there have been instances of other surface equipment failures resulting in minor gas releases. There currently is no requirement to report such releases. The regulations covering production operations on the OCS require redundant, fail-safe safety systems. These safety systems detect upsets and shut down the production process when an upset occurs, preventing most hydrocarbon releases.

As noted in the hypothetical scenario, associated and dissolved gases that are recovered along with the crude oil are expected initially to be reinjected or used as fuel and produced as sales gas starting in 2022.

IV.A.6.a. Accidental Gas Release During Exploration

A gas-well blowout during exploration drilling from shallow gas could be in the range of 5-10 million cubic feet. We expect that the event would not last more than 1 day and that the released gas would ignite and burn until the gas flow stops.

IV.A.6.b. Accidental Gas Release During Development and Production

Unlike oil spills, small amounts of gas may be released and usually flared as part of the routine, permitted operations. Also, during oil production, separation of solution gas from oil occurs on the platform. In the event of malfunction or emergency, processing equipment would shut down, which would limit the release, and gas most likely would be flared.

IV.A.6.c. Large Gas Release

During sales-gas production, which would commence in 2022, we assume a blowout of a single well on the platform would occur, releasing 10 million cubic feet of natural gas for 1 day and that the gas would ignite and burn until the gas flow stops. The rupture of a gas pipeline would result in a short-term release of gas. A sudden decrease in gas pressure automatically would initiate procedures to close those valves that would isolate the ruptured section of the pipeline and, thus, prevent a further escape of gas. Gas would bubble to the surface and continue into the atmosphere, where it would dissipate.

IV.A.6.d. Location of Accidental Gas Release Analysis

Analysis of gas releases and their effects is found in the following sections:

- Section IV.B.1. Alternative I – Proposed Action: Effects from Exploration, Routine Operations, Large Gas Releases.
- Section IV.B.2. Alternative II – No Action: Assumes no gas release occurs, because no action occurs.
- Sections IV.B.3 and IV.B.4. Alternatives III and IV – Lower Kenai Peninsula and Barren Islands Deferrals: Analysis of the difference, if any, between the effects of gas releases described for Alternative I and the effects of gas releases under Alternatives III and IV for Sales 191 and 199.
- Section V.C. Cumulative Effects: Analysis of Cumulative Effects by Resource.

IV.B. ANALYSIS OF EFFECTS OF COOK INLET OIL AND GAS DEVELOPMENT

This section presents an analysis of the effects of Alternative I on the physical, biological, and human environments.

IV.B.1. Alternative I – Proposed Action

IV.B.1.a. Effects of Sale 191 on Water Quality

For Alternative I for Sale 191, the activities associated with petroleum exploitation with the most potential to affect water quality in the Cook Inlet sale area are (1) the permitted discharges from exploration-drilling units and production platforms, (2) accidental oil spills, and (3) construction activities. The meteorological and oceanographic factors affecting the marine waters of Cook Inlet are described in Sections III.A.2 and III.A.3, and the characteristics of the waters are described in Section III.A.4. As noted in Section III.A.4, the quality of lower Cook Inlet water generally is good (i.e., unpolluted). The permitted discharges, any accidentally spilled oil, or offshore construction activities would add substances that may be foreign to or increase the concentration of constituents already present in the water column of Cook Inlet. In this discussion of water quality, non-framework-dependent units such as parts per million have been emphasized over English and metric units to minimize confusion. In this vein, a non-framework-dependent unit of weight can be approximated by using “tonnes,” representing both metric tonnes and English long tonnes, rather than English short tons. Weight in English long tonnes or metric tonnes is the same to third decimal place. English short tons are 10% lighter.

IV.B.1.a(1) Conclusion

The activities associated with petroleum exploitation are not likely to significantly affect water quality for Sale 191. An oil spill of 1,000 barrels or greater is not likely to occur and would not significantly degrade the quality of Cook Inlet water if it did occur. Drilling fluids and produced waters would be injected downhole during development and production. The remaining affecting activities—exploration discharges, small spills, and construction activities—would not significantly affect water quality

IV.B.1.a(2) Effects from Exploration

Drilling muds and cuttings are the most significant discharge during exploration drilling; other discharges are briefly mentioned in this section. The principal method for controlling exploration discharges is through Section 402 (33 U.S.C. § 1342) of the Federal Water Pollution Control Act (commonly referred to as the Clean Water Act) of 1972, which establishes a National Pollutant Discharge Elimination System (NPDES) (Laws, 1987). The types of pollutants regulated by the Environmental Protection Agency are shown in Table IV.B-1. The Cook Inlet general NPDES permit AKG285000 (Environmental Protection Agency, 1999) specifically allows for new oil and gas exploration (and delineation) discharges in Cook Inlet in waters greater than 5 meters deep. Discharge is prohibited in the portion of the sale area in Kamishak Bay west of a line from Cape Douglas to Chinitna Point. The general permit only covers the bulk of Cook Inlet north of a line between Cape Douglas on the west and Port Chatham on the east. This excludes the southernmost portion of the sale from exploration coverage under the general permit. Any exploration in this portion of the sale area would require a site-specific NPDES permit to discharge.

We assume that during the exploration phase of Alternative I for Sale 191, two exploration wells would be drilled—one in 2006 and one in 2009, and up to three delineation wells would be drilled—one in 2007 and two in 2008. We assume one drilling unit would be used each year to drill these wells; thus, only one well would be drilled at a time. Each exploration and delineation well would be drilled and completed over a 2- to 3-month period.

IV.B.1.a(2)(a) Drilling Muds and Cuttings

Drilling muds are mixtures of water and natural and manmade additives that are pumped downhole to (1) cool the rapidly rotating drill bit, (2) lubricate the drill pipe as it turns, (3) carry rock cuttings to the surface, and (4) provide well control and spill prevention. Typical bulk constituents of drilling muds are water, barite, bentonite (a clay mineral), lignosulfonate, and lignite (see Appendix B, Table B-4 for percentage composition of drilling mud). Water constitutes about 7- 85% of the volume of most drilling muds used in Cook Inlet (Neff, 1991). In the drilling muds, the amount of barite would be about 75% of dry mud weight, bentonite about 2%, and lignite about 1.4%, with no other constituent over a fraction of a percent. These constituents generally are nontoxic to marine organisms at the dilutions reached shortly after discharge (National Research Council, 1983). The current NPDES permit for Cook Inlet AKG285000 (Environmental Protection Agency, 1999) requires that the bulk drilling mud itself be practically nontoxic in order to be discharged (see Section IV.B.1.a.2.c). The discharge of drilling muds and cuttings likely would constitute the largest volume of discharges, other than seawater, during the exploration drilling.

IV.B.1.a(2)(b) Turbidity Water-Quality Criteria

The Environmental Protection Agency and State of Alaska criteria related to increasing the turbidity (cloudiness) in the water column are quite similar. The Environmental Protection Agency (1986) criterion for solids suspended and turbidity for freshwater fish and other aquatic life states: "Settable and suspended solids should not reduce the depth of the compensation point for photosynthetic activity by more than 10% from the seasonally established norm for aquatic life."

The State of Alaska, Department of Environmental Conservation (1999) water-quality criteria for turbidity specific to "marine-water uses for growth and propagation of fish, shellfish, aquatic life, and wildlife" states that increased turbidity "shall not reduce the depth of the compensation point for photosynthetic activity by more than 10%. In addition, [increased turbidity]…shall not reduce the maximum secchi disk depth by more than 10%."

A "mixing zone" is the area adjacent to a discharge or activity in the water where receiving water may not meet all the water-quality standards or criteria; wastes and water are given an area to mix so that the water-quality standards or criteria are met at the mixing-zone boundaries. As regulated by the State of Alaska, Department of Environmental Conservation (1999, a mixing zone shall:

1. neither partially nor completely eliminate an existing use of the waterbody outside the mixing zone; and
2. not impair the overall biological integrity of the waterbody).

The State will not authorize a mixing zone if

1. The pollutants discharged could
    a) bioaccumulate, bioconcentrate, or persist above natural levels in sediments, water or biota to significantly adverse levels…,
    b) be expected to cause carcinogenic, mutagenic, or teratogenic effects on, or otherwise present a risk to, human health, or
    c) otherwise create a public health hazard through encroachment on water supply or contract recreation uses of the waterbody.
2. There could be
    a) an adverse impact on anadromous or resident fish or shellfish spawning or rearing;
    b) a barrier formed to migratory species;
    c) failure to provide a zone of passage; or
    d) an adverse effect on threatened or endangered species.
3. Flushing or mixing of the waterbody is not adequate to ensure full protection of uses of the waterbody outside the proposed mixing zone; or
4. There could be an environmental effect, or damage to the ecosystem that the department considers to be so adverse that a mixing zone is not appropriate.

The State will reduce in size or deny a mixing zone if the pollutants discharged could:

1. Result in undesirable or nuisance aquatic life;
2. Produce objectionable color, taste, or odor in aquatic resources harvested for human consumption; or
3. Preclude or limit established processing activities or commercial, sport, personal-use, or subsistence fish and shellfish harvesting.

The size of each mixing zone must comply with the following limitations:

1. Water-quality criteria must be met at the boundary of the mixing zone. A discharge may not cause or reasonably be expected to cause (a) lethality to passing organisms in the mixing zone; or (b) a toxic effect in the water column, sediments, or biota outside the boundaries of the mixing zone."
2. Human health and chronic aquatic life criteria apply at and beyond the boundaries of the mixing zone.
3. Acute life criteria apply at and beyond the boundaries of a smaller initial mixing zone surrounding the outfall. This smaller zone must be sized to prevent lethality to passing organisms.

For estuarine and marine waters, measured at mean lower low water:

1. The cumulative linear length of all mixing zones intersected on any given cross-section of an estuary, inlet, cove, channel, or other marine water may not exceed 10% of the total length of that cross-section.
2. "The total horizontal area allocated to mixing zones in these waters may not exceed 10 percent of the surface area"; Section 403(c) of the Federal Water Pollution Control Act (Clean Water Act) regulations allow only a 100-meter radius mixing zone for initial dilution of discharges in OCS waters. The mixing zone means a limited area or volume of water where initial dilution of a discharge takes place and where numeric water quality can be exceeded, but acutely toxic conditions are prevented from occurring (40 CFR 131.35).

The suspended particulate matter concentrations we report in this section are in parts per million and cannot be directly correlated with Environmental Protection Agency and State criteria. Abernathy, Gilliam, and Klouda (1989) note that suspended-particulate matter concentrations in the 100-1,000 parts per million range (approximately 100-1,000 milligrams per liter) are known to have sublethal effects on some marine biota. Thus, for this analysis, a chronic criterion in terms of suspended-particulate matter rather than turbidity will be used. This assumed chronic range is from 100-1,000 parts per million of suspended-particulate matter. The particulate concentration in the drilling muds and cuttings at the time of discharge and after an initial mixing also can be compared to background suspended-particulate matter concentrations in the Cook Inlet water column, and this may be a more useful means of evaluating the effects of these discharges.

IV.B.1.a(2)(c) Sale 191 Exploration-Drilling Discharges

We estimate the drilling and completion of each exploration or delineation well will result in the discharge of an estimated 140 tonnes (metric dry weight) of mud and 400 tonnes of cuttings (see Appendix B for derivation of these estimates in English short tons). We estimate the total dry-weight discharge for drilling and completion of the eight exploration and delineation wells to be 950 tonnes of drilling-mud components and 2,800 tonnes of cuttings during a 4-year period. This amount of material is a fraction of the particulate matter that rivers discharge daily into Cook Inlet. The May-to-October mean-discharge rates and suspended-sediment loads for the major rivers discharging into Cook Inlet are shown in Table III.A-1.

Bulk drilling mud, usually about 16-32 cubic meters (100-200 barrels) at a time, is discharged several times during the drilling of a well when the composition of the drilling mud has to be changed substantially or when the volume exceeds the capacity of the mud tanks. Washed drill cuttings and a small volume of drilling-mud solids are discharged continuously during drilling operations; the discharge rate varies from about 4-40 cubic meters per day) (about 25-250 barrels)—the high amount is more characteristic of the discharges early in the drilling program (Menzie, 1982). When the drilling and testing of an exploratory well are complete, the operator may discharge the remaining 159-382 cubic meters (1,000-2,400 barrels) of used drilling mud. The Cook Inlet general NPDES permit AKG285000 (Environmental Protection Agency, 1999) states that: "the total drilling muds, drill cuttings, and washwater discharge rate shall not exceed" the following:

- 159 cubic meters (1,000 barrels) per hour in water depth greater than 40 meters,
- 119 cubic meters (750 barrels) per hour in water depth between 20 meters and 40 meters, and
- 79 cubic meters (500 barrels) per hour in water depths between 5 and 20 meters.

Drilling muds and cuttings discharged into Cook Inlet would increase the turbidity of the water column and the rate of accumulation of particulate matter on the seafloor near the drilling unit. The discharge of drilling muds at the surface ensures dispersion and limits the duration and amount of exposure to organisms (National Research Council, 1983). When released into the water column, the drilling mud and cutting discharges tend to separate into upper and lower plumes (Menzie, 1982). The upper plume contains the solids separated from the material of the lower plume and kept in suspension by turbulence. Most of the solids in the discharge, more than 90%, descend rapidly (within 1 hour) to the seafloor in the lower plume. The heaviest materials (for example, barite particles and cuttings) accumulate closest to the discharge point, and the lighter mud components settle farther away. Small particles of drilling mud—up to several centimeters in diameter—also may settle to the seafloor immediately following a discharge but would disperse within a day (National Research Council, 1983).

The fate of the drilling muds and cuttings discharged into Cook Inlet may be indicated by the continental offshore stratigraphic test (COST) well drilled in the summer of 1977 in lower Cook Inlet at a site between Kachemak and Kamishak bays (Dames and Moore, 1978) in waters about 50 meters deep. Dye studies and modeling of the discharge plume, conducted in conjunction with the drilling of the well, indicated rapid dilution to a minimum value of 10,000:1 within 100 meters (0.03 square kilometers) of the drilling vessel. Following dilution, the increase in turbidity caused by the discharge of drilling muds was calculated to be about 8 parts per million; background turbidity in the area ranged from 2-20 parts per million.

For waters deeper than 40 meters, modeling at discharge rates of 500, 750, and 1,000 barrels/hour and current speeds of 2-150 centimeters per second (about 0.04-3 knots), projected minimum solids-dilution rates were from about 1,000:1 to 6,000:1 at 100 meters. Dilution rates increased with increasing current speed and water depth and decreasing discharge rate (USDOI, MMS, Alaska OCS Region, 1995:Appendix J). Modeling also estimated the minimum dilution rates for dissolved substances to range from about 1,000:1-27,000:1.

The dynamic nature of the bottom-current regime at and near the COST well site appeared to have washed most of the mud from the cuttings and limited the accumulation of cuttings and mud (including some barite particles) to a rate that did not appear to significantly affect benthic populations. During the drilling of the COST well, strong tidal currents rapidly dispersed cuttings and barite particles that reached the seafloor; the maximum velocity of the currents was 99 centimeters per second (about 2 knots).

Dilution rates as high as 1,000,000:1 may occur for drilling solids within a distance to 200 meters (0.13 square kilometers) of a platform with surface currents of 30-35 centimeters per second (about 0.6-0.7 knots) (National Research Council, 1983). As noted in Section III.A.3, tidal currents in lower Cook Inlet may have velocities of 102-153 centimeters per second (about 2-3 knots), or more. The currents associated with the Cook Inlet circulation regime, especially the strong tidal currents, and the morphometry of the inlet produce considerable crosscurrents and turbulence in the water column during both ebb and flood tides (Sections III.A.3 and III.A.4). The cumulative effects of hydrodynamic processes suggest the water column in lower Cook Inlet generally is vertically well mixed. The similarities between the respective suspended particulate matter concentrations, salinities, and temperatures at the surface and near the bottom not only suggest vertical mixing but also show the cross-channel gradients that exist in the water column. These gradients indicate that dilution, rather than deposition, is the major process controlling suspended particulate matter concentrations in the central part of the inlet.

Only part of the solids in the drilling muds and cuttings discharged into Cook Inlet may accumulate on the seafloor near the discharge. The bottom currents in lower Cook Inlet are strong enough to prevent the deposition of sand-size and smaller particles (Sharma, 1979; Hampton, 1982b). Regional sediments indicate sorting by present-day transporting currents (Hampton, et al., 1981). Silts and muds are moved southward to outermost Cook Inlet and Shelikof Strait (Sharma and Burrell, 1970; Carlson et al., 1977; Hampton, 1982b; Boehm, 2001a).

The flow of Cook Inlet water generally is to the southwest. Discharged substances that are dissolved or remain in suspension generally would be transported out of Cook Inlet and into the Gulf of Alaska within about 10 months (Kinney, Button, and Schell 1969, 1970).

The density of any drilling muds discharged into Cook Inlet should range within 1,000-2,000 parts per thousand wet weight. This is a typical density range for used drilling mud. For example, Adams (1985) stated a range between 1,080 and 1,800 parts per thousand and the National Research Council (1983) a range (for OCS wells) of 1,190-2,090 parts per thousand. The particulate concentrations of the drilling discharges are expected to be greater than the approximated chronic criterion of 100-1,000 parts per million (see Section IV.B.1.a(2)(b) inside the Federal mixing zone, within about 100 meters of the discharge point. With a dilution rate of 10,000:1, the concentration of drilling mud initially would be reduced to 0.10-0.20 parts per thousand (100-200 parts per million) within 100 meters of the discharge site; a dilution rate of 1,000,000:1 would reduce the concentrations to 0.001-0.002 parts per thousand (1-2 parts per million) within 200 meters of the discharge site. Rapid settling of the heavier particles would result in greater reductions in the concentrations of the drilling muds inside 100-200 meters from discharge than were estimated by using only the dilution factors. The concentration of suspended particulate matter in the water column of lower Cook Inlet ranges from 1-50 parts per million (Section III.A.4). Thus, within about 100-200 meters of the discharge site, the concentration of particulate matter in the muds and cuttings discharged into the water column is expected to be reduced to levels comparable to the levels of naturally occurring suspended-particulate matter.

The drilling muds used in Cook Inlet generally have been of low toxicity (Alaska Oil and Gas Association, 1991; Neff, 1991), and the most recent general NPDES permit for Cook Inlet oil and gas discharges (AKG285000; Environmental Protection Agency, 1999) allows discharge of only muds with negligible toxicity as measured by 96-hour lethal concentration for 50% of test organisms (LC_{50}) tests. Toxicity is the inverse of the LC_{50}; as the LC_{50} value increases, the toxicity associated with the substance decreases. For example, a substance with an LC_{50} of 1 million parts per million is less toxic than a substance with an LC_{50} of 3,000 parts per million. The classification of relative toxicity of chemicals to marine organisms proposed by the IMCO/FAO/UNESCO/WHO, reported in Neff (1991), provides a means of qualitatively assessing relative toxicities. Concentrations less than 1 part per million are classified as very toxic; 1-100 parts per million are toxic; 100-1,000 parts per million are moderately toxic; 1,000-10,000 parts per million are slightly toxic; and greater than 10,000 parts per million are practically nontoxic. The current NPDE System permit for Cook Inlet AKG285000 (Environmental Protection Agency, 1999) requires LC_{50} greater than 30,000 parts per million in discharged muds. The toxicity (LC_{50}) of the muds used to drill 39 production wells in Cook Inlet between August 1987 and February 1991 (under older permits) ranged from 1,955 to greater than 1,000,000 parts per million for a marine shrimp (Alaska Oil and Gas Association, 1991; Neff, 1991). The percentage of the wells with toxicities (1) greater than 100,000 parts per million was 79%, (2) between 10,000 and 100,000 parts per million was 10%, and (3) between 1,000 and 10,000 parts per million was 10%.

IV.B.1.a(2)(d) Other Discharges

In addition to the drilling muds and cuttings, a variety of other permitted discharges associated with exploration drilling may be released into the waters of Cook Inlet; the characteristics of these discharges were summarized in the Sale 149 Final EIS (USDOI, MMS, Alaska OCS Region, 1995). The types and volume ranges of the discharges for exploration wells drilled in other Alaskan OCS planning areas are shown in Table IV.B-2. Many of these discharges also are associated with production operations, and the types and amounts of additives in the discharges associated with exploration-drilling operations are assumed to be similar to the production-related discharges. The typical compounds and the amounts used and potentially discharged are shown in Table IV.B-2. The types and amounts of compounds used will vary with each operation, and the table shows only examples. Dispersion in the receiving waters would further decrease the concentration of any additives. Seawater is the principal component of most of the discharges—in some cases, seawater is the only constituent.

Sanitary and domestic wastes are monitored in accordance with the NPDES permit AKG285000. The term “sanitary wastes” means human body waste discharged from toilets and urinals; “domestic wastes” means wastes from showers, sinks, galleys, and laundries (Environmental Protection Agency, 1986). Sanitary and domestic wastes could range between 11 and 23 cubic meters per day and 15 and 27 cubic meters per day, respectively (Table IV.B-2). Daily maximum concentrations in discharge are no foam or floating solids and total residual chlorine of 19 parts per million for domestic wastes. Discharged sanitary wastes are required to have at least 1 part per million total residual chlorine, biological oxygen demand of no more than 60 parts per million, and suspended-particulate matter of no more than 60-67 parts per million.

These discharges (other than muds and cuttings) are expected to represent only small pollutant loadings when properly designed and functioning equipment is used. Dilution rates for some of the other discharges may be less than those estimated for the drilling muds. As will be discussed in Section IV.B.1.a(3), the dilution rates for produced waters have been estimated to range from 1,020:1-1,550:1.

IV.B.1.a(2)(e) Summary of Effects of Drilling Muds and Cuttings and Other Discharges on Water Quality

The discharge of drilling muds and cuttings and other discharges associated with exploration drilling are not expected to have any measurable effect on the overall quality of the Cook Inlet water. Within a distance of between 100 and 200 meters from the discharge point, the turbidity caused by suspended-particulate matter in the discharged muds and cuttings is expected to be diluted to levels that are less than the chronic criteria (100-1,000 parts per million) and within the range associated with the variability of naturally occurring suspended-particulate matter concentrations. Mixing in the water column would reduce the toxicity of the drilling muds that already fall into the "practically nontoxic" category, to levels that would not be harmful to organisms in the water column. In general, the amounts of additives in the other discharges are expected to be relatively small (from 4 to 400 or 800 liters per month) and diluted with seawater several hundred to several thousand times before being discharged into the receiving waters.

IV.B.1.a(3) Effects from the Development Project

In the development and production scenario for Alternative I for Sale 191, one oil- and gas-production platform would be installed in the sale area in 2011. From this platform, 48 production and 12 injection wells would be drilled using one drilling rig. During the first year (2011), 8 wells would be drilled. In years 2012, 2013, and 2014, 16, 16, and 14 wells would be drilled, respectively. In the scenario, oil production would start in 2011 and continue through 2025, and an assumed 140 million barrels of oil would be produced during this time. Production would peak from 2012 through 2014 at 18.3 million barrels of oil each year. Gas sales would begin in 2022 and continue into 2033. Peak gas throughput would occur in 2024 through 2031 at 17.9 billion cubic feet per year. The water-quality effects associated with the operation of a Sale 191 production platform would begin in 2011 with the drilling of the production and service wells and are assumed to last through 2033, the last year of the estimated gas-production period; for a total of 23 years for the development and production phase.

Operations associated with the drilling of production and service wells and oil production generate a variety of permitted discharges that include drilling muds and cuttings, produced waters, and various other discharges that are summarized in this section. These discharges may be intermittent or continuous. The production discharges often contain a variety of chemicals used to improve or restore production, prevent or inhibit the growth of bacteria, inhibit corrosion and the formation of scale, improve separation of oil from water, and clean facilities.

Between April 10, 1987, and April 10, 1988, the petroleum companies operating the oil- and gas-production facilities in upper Cook Inlet conducted a monitoring program (Cook Inlet Discharge Monitoring Study) to identify the following: (1) the various types and amounts of chemicals used and discharged, (2) the characteristics of certain waste streams, and (3) the acute toxicity to marine life of the produced waters (EBASCO Environmental, 1990b). The information from this monitoring program, and other sources, is used to evaluate the characteristics and effects of some of the discharges that could be released from the Sale 191 production platform. Although the monitoring program was conducted about 20 years after production began in Cook Inlet, the information it provides is associated with a variety of reservoir conditions and crude-oil-production rates that, in 1990, the Alaska Oil and Gas Association (1991) estimated to range from 300-6,800 barrels per day for the 14 oil-production platforms (Table III.A-8); average produced water outputs ranged from 30-40,300 barrels per day.

IV.B.1.a(3)(a) Permitted Discharges

The principal method for controlling pollutant discharges is through Section 402 (33 U.S.C. § 1342) of the Federal Water Pollution Control Act (commonly referred to as the Clean Water Act) of 1972, which establishes the NPDES (Laws, 1987). The types of pollutants regulated by the Environmental Protection Agency are shown in Table IV.B-1. The most significant discharges associated with offshore operations and the discharges that have received the most attention are (1) drillings and cuttings and (2) produced water; the analysis in this section primarily focuses on these two discharges.

Estimates are presented in this section on the amount of muds and cuttings and produced waters that might come from a Sale 191 production platform; these estimates are based on discharge rates that are assumed to be characteristic of "present-day" drilling and oil-production operations in upper Cook Inlet, which began in the late 1960's. However, note that the Environmental Protection Agency is moving toward a goal of zero discharge from offshore oil and gas platforms.

We expect the Environmental Protection Agency to continue toward this goal in permitting any new production platform such as would occur from Sale 191. The most recent Cook Inlet general oil and gas NPDES general permit AKG285000 (Environmental Protection Agency, 1999) specifically allows for new oil and gas exploration discharges throughout most of Cook Inlet and grandfathers development and production discharges only from existing platforms under 'The Cook Inlet Exemption." This exemption is set forth in coastal subcategory guidelines (Environmental Protection Agency, 1996) and does not apply to the OCS, which falls into the offshore subcategory.

The rationales given for the Cook Inlet Exemption in the coastal subcategory are primarily economic or technical, not environmental; and are summarized in (Prentki, 1995). The subcategory exemption from zero discharge of drilling fluids and drill cuttings were based on the small volumes of such discharge expected from existing Cook Inlet platforms, the effect of weather and transportation logistics, cost effectiveness, and other factors such as types of fluids used and their composition and toxicity (Environmental Protection Agency, 1995, 1996). The rationale for proposing a coastal subcategory exemption for Cook Inlet from zero discharge of produced waters was based on the technical unfeasibility of reinjecting produced waters in Cook Inlet (inappropriate geological formations, scaling, and hydrogen sulfide formation in piping, reservoir plugging and souring in reinjection into the producing formation) and lack of any cost-effective alternative to reach zero discharge (Environmental Protection Agency, 1995, 1996). The Environmental Protection Agency determined that unacceptable economic impacts would occur to existing Cook Inlet operators, with the Agency's analysis showing that 3 of 13 platforms would be shut-in if discharge of produced water was prohibited. The Environmental Protection Agency, however, was very clear that the Cook Inlet Exemption would not be applied to new Cook Inlet oil and gas development in either coastal or offshore subcategories.

In fact, discharges of muds, cuttings, and produced waters were last authorized for a new Cook Inlet platform in 1986. The Osprey Production Platform, the first new platform in Cook Inlet since 1986, is not allowed to discharge muds, cuttings, or produced waters under its NPDES permit (AK0053309; Environmental Protection Agency 2002) and will instead inject them.

Thus, we do not anticipate production discharge of muds, cuttings, and produced waters will occur as a result of Sale 191. Instead, we anticipate that produced waters will be injected and muds and cuttings either ground and injected or barged for shore disposal (Appendix B).

IV.B.1.a(3)(b) Drilling Muds and Cuttings

During the drilling of production and service wells from a platform, on an average, dry-weight basis, an estimated 70 tonnes of drilling-mud components and 500 tonnes of cuttings per well will need to be disposed. The drilling of the production and injection wells from a single platform involves recycling some of the drilling muds to drill subsequent wells, and this amount varies from well to well. The total dry-weight discharges from drilling 60 production and injection wells are estimated to be 4,100 tonnes of drilling-mud components and 30,000 tonnes of cuttings in 2011-2014 and 2023-2024.

The characteristics of drilling mud use and the discharge of the muds and cuttings during the drilling of the production and service wells basically would be the same as those described for the drilling of the exploration wells as previously described in Section IV.B.1.a(2)(a).

As noted in Section IV.B.1.a(2)(c), drilling muds and cuttings would not be expected to degrade Cook Inlet water quality if discharged. However, new production platforms in Cook Inlet are expected to inject these drilling fluids or barge them to shore, based on current new-source guidance and Environmental Protection Agency NPDES permitting (Environmental Protection Agency, 1999, 2002).

IV.B.1.a(3)(c) Produced Waters

Just as for muds and cuttings, the discharge of produced waters is not anticipated. Instead, produced waters are expected to be injected back into underlying formations as is being done for the Osprey platform, the only new platform to be permitted in Cook Inlet since 1986 (Environmental Protection Agency, 2002).

However, produced water has been a scoping issue for Cook Inlet because of the types and amounts of naturally occurring substances they may carry and the manmade substances that may be added and because of Cook Inlet Exemption to zero discharge (Environmental Protection Agency, 1996). Historically, produced waters constituted the largest source of substances discharged into the marine environment. These waters are part of the oil/gas/water mixture produced from the wells and contain (1) a variety of substances dissolved from the geologic formations through which they migrated and in which they became trapped and (2) the soluble fractions of any hydrocarbons they might have encountered. These can include small quantities of Naturally Occurring Radioactive Materials (NORM), although concentrations from freshwater formations such as occur in Cook Inlet are usually low. The mixtures produced from the wells also may contain substances added to the waters injected into the producing formations and may contain chemicals added during the oil/gas/water separation process (EBASCO Environmental, 1990a, 1990b; Envirosphere Company, 1987).

Additives to the injection waters might include flocculants, oxygen scavengers, biocides, cleansers, and corrosion inhibitors; the types and amounts of additives used will depend on the reservoir and production conditions. During the Cook Inlet Discharge Monitoring Study of production platforms in Cook Inlet in 1987 and 1988, the types of additives added to the injected waters varied among the platforms and the amounts ranged from less than 0.04 to 1.4 cubic meters per month per platform (EBASCO Environmental, 1990a).

A variety of chemicals may be added to the oil/water separation process to aid in separating the oil and gas from the water. The most commonly used types of compounds added to the production stream include scale inhibitors, emulsion breakers, biocides, and corrosion inhibitors. During the Cook Inlet Discharge Monitoring Study of production platforms in Cook Inlet, the types of additives added to the oil/gas separation process varied and the amounts ranged from less than 0.004 to about 0.42 cubic meters per day per platform (EBASCO Environmental, 1990a). The concentration and toxicity ranges of some of the produced water treatment additives are noted in Section III.A.4.

Over the life of a field, the volume of formation waters produced may be equal to 20-150% of the oil-output volume (Collins et al., 1983). As oil is pumped from a field, the ratio of water to oil being produced increases. For example, in 1970, several years after production began, the Cook Inlet oil fields were producing between 0.02% and 0.1% water. In 1990, these fields were producing between 0.4% and 5.2% water (State of Alaska, Dept. of Natural Resources, 1970; State of Alaska, Oil and Gas Conservation Commission, 1990). In 2001, these fields were producing between 0.3% and 6.2% water (State of Alaska, Oil and Gas Conservation Commission, 2002). From the 1960's to the end of 2001, approximately 1,030 million barrels of oil and 155 million cubic meters (978 million barrels) of water were produced principally from four offshore oil fields in upper Cook Inlet (State of Alaska, Oil and Gas Conservation Commission, 2002).

Gas production also can coproduce water. From the 1960's to the end of 2001, approximately 1,518 billion cubic feet of gas and 0.12 million cubic meters of water were produced principally from offshore gas fields in upper Cook Inlet (State of Alaska, Oil and Gas Conservation Commission, 2002). In 2001, these individual gas fields were producing 0-0.5 cubic meters of water per million cubic feet of gas.

Based on these ratios, the amount of water produced as a consequence of producing 140 million barrels of oil and 190 billion cubic feet of gas could total 21 million cubic meters. Only 16,000 cubic meters of this water would be from gas production. During peak oil production, the annual amount of produced waters might range from 0.06-0.29 million cubic meters. Toward the end of oil production, the annual amount of produced water could increase to 0.1-2.1 million cubic meters. This produced water carries contaminants as discussed in Section IV.B.1.a(3)(c)1) below.

IV.B.1.a(3)(c)1) Characteristics of the Produced Waters

The characteristics projected for the produced waters from Alternative I for Sale 191 are based primarily on the characteristics of waters produced between April 1987 and April 1988 from the Cook Inlet platforms with additional data collected in 1998 (Tables III.A-9 and III.A-10). Measurements of the discharge were taken from the discharge streams prior to mixing with the receiving waters of Cook Inlet.

As noted in Section III.A.4, the treatment process removes suspended oil particles from the waters but the effluent contains dissolved hydrocarbons or those held in colloidal suspension. The treated produced waters contain the more soluble low-molecular weight saturated and aromatic hydrocarbons. The toxicity of produced waters mainly is caused by hydrocarbons (Brown et al., 1992). On this basis, the analysis of the effects of produced-water discharges focuses on nonvolatile hydrocarbons (Environmental Protection Agency's oil and grease) and total aromatic hydrocarbons, two of the characteristics measured and listed in Table III.A-9 that can be related to water-quality criteria. Other characteristics of the produced waters discussed in this section are based on those features that also can be related to water-quality criteria or compared to existing parameters in the water column. These characteristics include toxicity, pH, salinity, biological oxygen demand, and metal concentrations.

IV.B.1.a(3)(c)2) Water Quality Criteria for Hydrocarbons

The State of Alaska water-quality criteria for marine-water uses (1999), specific to the growth and propagation of fish, shellfish, aquatic life, and wildlife, state that total hydrocarbons in the water column shall not exceed 15 micrograms per liter (15 parts per billion). In addition, the State of Alaska water-quality criteria (1999) state that total aromatic hydrocarbons in the water column shall not exceed 10 micrograms per liter (10 parts per billion). These limits originally derive as a hundredfold safety factor, 0.01 of the lowest measured continuous flow 96-hour LC_{50}, for life stages of species identified by the Alaska Department of Environmental Conservation as the most sensitive biologically important species in a particular location (State of Alaska, Dept. of Environmental Conservation, 1989).

The water-quality criteria are intended to represent the water-soluble or water-accommodated fraction of a crude or refined oil similar to that used in many laboratory acute and chronic toxicity tests (Neff and Douglas, 1994). The water-soluble fraction includes primarily low-molecular-weight aromatic hydrocarbons, such as benzene, toluene, ethylbenzene, and total xylenes, with lesser amounts of naphthalene, alkylnaphthalenes, phenanthrene, and light aliphatic hydrocarbons.

The Environmental Protection Agency's water-quality criteria for marine waters (1991) do not include the total hydrocarbon or total aromatic categories found in the State criteria. Instead, the Environmental Protection Agency criteria include (1) criteria for oil and grease and (2) both acute and chronic criteria for the individual hydrocarbons.

Under the prior general NPDES permit (Environmental Protection Agency, 1986), the monthly average discharge limitation was 48 parts per million for nonvolatile hydrocarbons (oil and grease), and the maximum daily limitation was 72 parts per million. Under the current general NPDES Cook Inlet discharge permit (Environmental Protection Agency, 1999), covering only existing platforms, the monthly average discharge limitation for nonvolatile hydrocarbons (oil and grease) has been reduced to 15 parts per million for one gas platform and 29 parts per million for multiple oil platforms. The maximum daily discharge limitation has been reduced to 20 parts per million for gas platform and 42 parts per million for oil platforms. The NPDES permit for the Osprey platform (Environmental Protection Agency, 2002), which is the only new platform since 1986, does not permit discharge of oil and grease.

Information based on toxicity tests is used to establish criteria that may be considered a measure of water quality. Chronic toxicity tests measure the sublethal effects of substances on such factors as growth, development, reproduction, or behavior. Acute toxicity tests determine the concentration of a substance that causes the mortality (that is., lethal effects) of some fraction of the test population (for example, half of the population in the LC_{50} test) during a certain period of time (usually 4 days [96 hours]). Most of the information on toxicity is based on the results of acute toxicity tests and, where there are no chronic toxicity tests, an application or safety factor is used to extrapolate to probable sublethal effects. For most toxicants, the chronic toxicity is estimated to one-hundredth (0.01) to one-thousandth (0.001) of the acute toxicity. For this analysis, the acute criterion is assumed to be 100 times greater than the chronic criterion, which results in the chronic criterion being 0.01 of the acute criterion. The chronic criterion for total hydrocarbons, 15 parts per billion, may range from about 10-75 times greater than the background level of total hydrocarbons (about 0.2-1.5 parts per billion) in Cook Inlet.

IV.B.1.a(3)(c)3) Nonvolatile Hydrocarbons (Oil and Grease) and Total Aromatic Hydrocarbons

Nonvolatile hydrocarbons, the Environmental Protection Agency's "oil and grease," (oil and grease) consist of a variety of organic substances including hydrocarbons, fats, oils, and waxes (Table IV.B-1). The Environmental Protection Agency's gravimetric method of determining oil and grease measures certain classes of carbon compounds such as fatty acids, phenols, and related compounds (Table IV.B-1) that do not significantly contribute to the toxicity of produced waters (Brown et al., 1992). The fate of any petroleum hydrocarbons released into the water column along with the produced waters is expected to be similar to the fate of spilled oil in seawater, as described in Section IV.A.2; the discharged substances are affected by chemical and biochemical degradation processes, evaporation, and dissolution and dispersion.

The quantities of nonvolatile hydrocarbons (oil and grease) and total aromatic hydrocarbons we estimate to be in the Sale 191 produced water are based on the current NPDES permit limits for existing Cook Inlet discharges and measured produced-water concentrations. The Environmental Protection Agency's (1999) maximum daily limit for nonvolatile hydrocarbons (oil and grease) is 42 parts per million and maximum monthly average is 29 parts per million. The Environmental Protection Agency's maximum daily limit for total aromatic hydrocarbons ranges from 24.5-298 parts per million and maximum monthly average ranges from 12.2-205 parts per million. For reference, the mean concentrations reported in the discharges for the three onshore production treatment facilities (Granite Point, Trading Bay, and East Foreland), under the prior NPDES permit (Environmental Protection Agency, 1986), are shown in Tables III.A-9 and III.A-10. The mean concentrations of nonvolatile hydrocarbons (oil and grease) ranged from about 19-36 parts per million, and the total aromatic hydrocarbons ranged from about 8-13 parts per million. Thus, the current NPDES permit required a reduction in the upper concentration range for nonvolatile hydrocarbons (oil and grease) to a maximum monthly average of 29 parts per million. The total aromatic hydrocarbon concentrations reported in the table already meet this permit limit.

The amount of nonvolatile hydrocarbons (oil and grease) contained in 21 million cubic meters of produced waters at 29 parts per million average concentration projected under the Alternative I for Sale 191 scenario is 610 tonnes. During peak production (18.3 million barrels of oil/year), the amount of nonvolatile hydrocarbons contained in the produced waters might range from about 2-8 tonnes per year. Toward the end of oil production, the amount could peak at 3-60 tonnes per year (8-160 kilograms per day).

The mean concentration of total aromatic hydrocarbons in the produced waters from the treatment facilities ranged from about 8-13 parts per million (Tables III.A-9 and III.A-10). Using these concentrations, the aromatics contained in the produced waters from the assumed production platform in Alternative I for Sale 191 ranges from about 170-270 tonnes. During peak production, the annual total aromatic hydrocarbons loading in the produced waters might range from 0.5-3.7 tonnes (1-10 kilograms per day). Toward the end of oil production, the annual total aromatic hydrocarbons loading could peak at 0.8-27 tonnes (2-74 kilograms per day).

IV.B.1.a(3)(c)4) Effects of Mixing

Although we expect produced waters to be reinjected rather than discharged, we can estimate the effects on water quality if such permitted discharge were to occur. Produced waters discharged into the mixing zone would have the concentrations of the nonvolatile hydrocarbons averaging 29 parts per million or less and total aromatic hydrocarbons at 8-13 parts per million. Mixing of the produced waters with the receiving waters reduces the concentrations of the substances in the discharges. Based on modeling, the Environmental Protection Agency (reported in Alaska Oil and Gas Association, 1990) has estimated dilution to be 1,550:1 at 625 meters distance for production platforms in upper Cook Inlet and 1,020:1 at 750 meters for the Trading Bay Production Facility.

The nonvolatile hydrocarbons (oil and grease) in the produced waters from an oil-production platform would be diluted a thousandfold within several hundred meters if discharged. At a 1,000:1 dilution, the concentrations of nonvolatile hydrocarbons would reduce from 29 parts per million to 29 parts per billion within several hundred meters of the platform. The concentrations of total aromatic hydrocarbons might range from 8-13 parts per million close to the platform and 8-13 parts per billion. These concentrations at several hundred meters distance are well below the acute criteria of 1,500 parts per billion for the nonvolatile hydrocarbons and 1,000 parts per billion for the total aromatic hydrocarbons that were assumed for this analysis but, in general, slightly greater than the chronic criteria of 15 parts per billion for the nonvolatile hydrocarbons and 10 parts per billion for the total aromatic hydrocarbons. At some point within this several-hundred-meter distance, acute and chronic criteria would be exceeded. In OCS waters, mixing zones (see Section IV.B.1.a(2)(b)) are limited to a 100-meter radius. This limitation does not apply to State waters, where mixing zones can be expanded the necessary several hundred meters to ensure that these criteria are not exceeded outside the mixing zone. At the contaminant concentrations, dilution rates, and volumes estimated here, a Sale 191 operator wishing to discharge produced waters would have difficulty in meeting Federal water quality criteria at the edge of the mixing zone: reinjection of produced waters would be the more viable option.

Note, however, that mixing is a continuous process, and the dilution rate will depend on the local receiving environment's energy as derived from the local currents and waves. Evaporation will remove some of the aromatic hydrocarbons from the water column; Jordan and Payne (1980) note that evaporation may remove the majority of the more volatile compounds within 24-28 hours after an oil spill. In addition, biodegradation processes act to continuously change the hydrocarbon compounds in the waters. Kinney, Button, and Schell (1969) found that oil-oxidation by microbes was the primary removal process for Cook Inlet crude spilled or discharged in Cook Inlet, with the process essentially complete within 1-2 months.

IV.B.1.a(3)(c)5) Some Other Characteristics of Produced Waters

Other characteristics of the produced waters from the upper Cook Inlet production platforms shown in Tables III.A-3, III.A-9, and III.A-10 include trace metals, pH, salinity, and biological oxygen demand. The current NPDES permit limitations are provided in Table IV.B-3. The mean pH (field) ranged from 6.5-7.5; the general NPDES permit discharge limitation ranges from 6-9. The pH of surface seawater generally is about 8.2 (Millero and Sohn, 1991). The mean salinity of the produced waters from the treatment facilities ranged from about 21-34 parts per thousand and from the platforms about 5-14 parts per thousand. As noted in Section III.A.4, the salinities in lower Cook Inlet range from about 26 parts per thousand at the Forelands to 32 parts per thousand at the entrance and about 32 parts per thousand in Shelikof Strait; salinities near the mouths of rivers and streams may be about 5 parts per thousand.

The biological oxygen demand and metal amounts produced from the production platform can be compared with the amounts found in other point sources (Table IV.B-4). Produced waters are a minor potential source of these contaminants.

Naturally Occurring Radioactive Materials (NORM) should be expected to occur in low concentrations in produced waters. The NORM is best monitored indirectly, taking advantage of natural biological or chemical concentration mechanisms such shell formation (Farrington et al, 1983; Goldberg et al., 1983). The University of Alaska Anchorage (UAA), Environment and Natural Resources Institute (ENRI) (1995) analyzed mussel shells from sites in Cook Inlet and found very low NORM levels in all shells analyzed. Radium-226, radium-228, and bismuth-214 were not detectable and lead-214 was extremely low. Because these shells integrate NORM from all sources, the overall conclusion is NORM is not a significant contaminant in Cook Inlet from Cook Inlet produced water or other sources.

IV.B.1.a(3)(c)6) Toxicity

The toxicity of the produced waters from the oil and gas fields of upper Cook Inlet was determined by using a standard 96-hour static acute-toxicity test to the mysid shrimp *Mysidopsis bahia* (EBASCO Environmental, 1990a); this test measures the concentration killing 50% of the test animals in 96 hours (LC_{50}). (*Mysidopsis bahia* routinely has been used to evaluate the toxicity of effluents from municipal wastewater-treatment plants, refineries, and chemical manufacturing plants to marine organisms [Brown et al., 1992]). The LC_{50} toxicities of the produced waters ranged from 0.27-82.47% of the effluent (Table III.A-9); these concentrations equal 2,700-824,700 parts per million. Based on the qualitative toxicity levels described in Section IV.B.1.a(3)(c)1), the produced waters sampled during the Cook Inlet Discharge Monitoring Study Program would range in toxicity from slightly toxic to practically nontoxic prior to discharge and subsequent mixing in the water column.

IV.B.1.a(3)(c)7) Summary of Effects of Produced-Water Discharge on Water Quality

Produced waters from a Sale 191 production platform would likely be injected into underlying formations. Even if discharged, produced waters would not be expected to degrade the quality of Cook Inlet water.

IV.B.1.a(3)(d) Other Discharges

Based on the recent NPDES permit for the Osprey platform (Environmental Protection Agency, 2002), a small list of other permitted production discharges is likely for any new Cook Inlet platforms. These are deck drainage, sanitary wastes, domestic wastes, boiler blowdown, fire-control-system test water, noncontact cooling water, and excess cement slurry (Environmental Protection Agency, 2002). Although allowed by permit, the Osprey platform will not discharge deck drainage but will instead inject the drainage into a disposal well (Taylor and Seamount, 2002). The characteristics of such discharges are summarized in USDOI, MMS, Alaska OCS Region (1995). The types and volume ranges of the discharges for exploration wells drilled in other Alaska OCS planning areas are shown in Table IV.B-2. The types of compounds and the amounts that might be used in drilling and disposed of are shown in Table IV.B-2. The types and amounts of compounds used will vary with each operation, and the information shown in the table is presented as possible examples. If discharged, dispersion in the receiving waters would further decrease the concentration of any additives. Seawater is the principal component needing disposal—in some cases, seawater is the only constituent.

Sanitary and domestic wastes would be disposed of in accordance with a NPDES permit, such as is being done under the current Cook Inlet general permit AKG285000, as discussed for exploration discharges in Section IV.B.1.a(2). These discharges (other than muds and cuttings) are expected to represent only, nonsignificant small pollutant loadings when properly designed and functioning equipment is used (USDOI, MMS, Alaska OCS Region, 1995). Dilution rates for some of the other discharges may be less than those estimated for the drilling muds, but at least as high as for produced waters.

IV.B.1.a(4) Oil Spills

Accidental oil spills are possible in the sale area, if oil is produced as a result of Sale 191.

IV.B.1.a(4)(a) Fate of Petroleum in Seawater

Petroleum released into seawater is exposed to a variety of physical, chemical, and microbiological processes that operate interdependently and simultaneously with each other to degrade and, eventually, remove it from the water column (Karrick, 1977). The fate of petroleum in seawater is discussed in Sections III.A.4 and IV.A.2. During the degradation process, some of the various constituents of the spilled oil will spread over the sea surface, evaporate into the atmosphere, disperse and dissolve into the water column, form water-in-oil emulsions, wash onto beaches and sink to the seafloor, and change by chemical and microbiological processes.

IV.B.1.a(4)(b) Oil Spills Less Than 1,000 Barrels

Only small, accidental oil spills likely would occur in the sale area, if oil production (140 million barrels) occurs as a result of Sale 191 (Section IV.A.4.b). Although by definition, small spills could be almost 1,000 barrels in size, the average small spill is a tenth of a barrel (0.016 cubic meters). The total estimated spillage from small spills is about 482 barrels (77 cubic meters). Over the 23 years of production, an average of 205 small spills per year would be expected, for a total of 21 barrels per year (3.3 cubic meters per year). This is the same magnitude as is discharged into upper Cook Inlet as oil and grease in produced waters.

As a basis for comparing the effects of “small” and “large” spills on the water quality, the concentrations of oil that has been dispersed into the water column can be estimated simply by (1) using the amount of oil spilled and the estimated size of the affected area and (2) assuming a depth of mixing and homogeneity of dilution. As an example, a spill of 5 barrels in the summer, the size of the discontinuous area affected by the release of 5 barrels of oil into the waters of lower Cook Inlet is estimated to be about (1) 1.7 square kilometers after 3 days, (2) 8.8 square kilometers after 10 days, and (3) 34 square kilometers after 30 days; the size of a whole OCS lease block is 23.04 square kilometers (USDOI, MMS, Alaska OCS Region, 1995:Table IV.A.3-3). In addition to the assumptions used to calculate the size of the discontinuous area of the spill, the dispersed oil concentration estimates depend on the following premises: (1) the estimated amount of oil dispersed during summer into the water column after 3, 10, and 30 days at 25, 37, and 42%, respectively, of the amount spilled (Ford, 1985) and (2) a subsurface plume of dispersed oil equal in area to the discontinuous area of slick coverage on the surface.

The waters of lower Cook Inlet generally are vertically well mixed and strongly influenced by the tidal cycle. The mean daily tidal range in lower Cook Inlet is on the order of 5 meters; the mean range at Seldovia, Nikishka, and Drift River Terminal is 5.5, 6.2, and 5.5 meters, respectively (Brower et al., 1988). For the depth-of-mixing estimates, we assume the oil is dispersed into the water column to a depth equivalent to the tidal range (5 meters) after 3 days; during this time interval, the area affected by the spill will have experienced six tidal cycles. At the end of 10 days, we assume the oil is dispersed to a depth of 10 meters; during this time there will have been about 20 tidal cycles and 2-3 changes in the meteorological events that affect wind-driven waves and surface currents. At the end of 30 days, we assume the oil dispersed to a depth of 30 meters; during this time there will have been about 60 tidal cycles and 7-10 changes in the meteorological events that affect wind-driven waves and surface currents.

For a 5-barrel spill at the end of 3 days, the concentration of dispersed oil is estimated to be 20 parts per billion in waters about 5 meters deep and covering 1.7 square kilometers. With time, the size of the discontinuous area and the depth of mixing increases, and the concentration of the dispersed oil decreases. The estimated concentrations of dispersed oil after (1) 10 days is 3 parts per billion in waters 10 meters deep and covering 8.8 square kilometers, and (2) 30 days is 0.3 parts per billion in waters 30 meters deep and covering 34 square kilometers.

For a larger "small" summer spill, for instance, a 160-barrel spill, the estimated amount of oil dispersed into the water column after 3, 10, and 30 days is 15, 30, and 39%, respectively (USDOI, MMS, Alaska OCS Region, 1995:Table IV.A.3-3). Based on the same assumptions as used for the 5-barrel spill, estimates of the sizes of the discontinuous areas and concentration of oil dispersed from a 160-barrel spill indicate that after 3 days, the concentration of dispersed oil is estimated to be 61 parts per billion in waters estimated to be 5 meters deep and covering about 11 square kilometers. The estimated concentration of dispersed oil after (1) 10 days is 14 parts per billion in waters 10-meters deep and covering 48 square kilometers, and (2) 30 days is 1 part per billion in waters 30-meters deep and covering 199 square kilometers.

The simplified estimates of the amount of dispersed oil in the water column indicate that, immediately after a spill, the concentration of spilled oil in a relatively small area may exceed the State of Alaska total hydrocarbon criterion of 15 parts per billion; the concentrations are, however, below the acute criterion of 1,500 parts per billion assumed for this analysis. In addition, the hydrodynamic processes act to continuously disperse the oil and dilute the concentrations. The other processes that degrade oil and remove it from the water column such as sedimentation and biodegradation occur but are too difficult to quantify to include in the concentration estimates.

The general NPDES discharge permit limits on the amount of oil and grease (nonvolatile hydrocarbons) allowed in the produced waters discharged into upper Cook Inlet waters are 29 parts per million monthly (average) and 42 parts per million daily. Dilution in a mixing zone of some of the substances dissolved or suspended, such as oil and grease in discharges from petroleum-exploration-drilling units or production platforms would be on the order of 1,000:1. These dilution rates suggest that dilution of spilled oil may be more rapid than is indicated by our estimates in this section for 5- and 160-barrel spills.

However, the area affected by spilled oil may differ from that predicted from wind, temperature, and wave-height conditions. The midchannel tide "rip" or convergence zone in lower Cook Inlet is an area where spilled oil, along with other floating debris, tends to accumulate (Whitney, 1994). In the central part of lower Cook Inlet between Kalgin Island and Port Graham, the chance that spilled oil would be transported into the midchannel convergence zone is greater than 80% (Whitney, 1994). In the convergence zone, the size of the discontinuous area covered by an oil slick probably would be less than that we assume for this analysis and the concentration of oil would be greater.

Summary of Effects of Small Oil Spills (Less than or Equal to 1,000 Barrels) on Cook Inlet Water Quality. We do not expect small oil spills, as represented in this analysis by 5- and 160-barrel spills, to have any degradational effects on the overall water quality of Cook Inlet. The small spills would degrade the water quality for a relatively short time, perhaps up to about 10 days, in areas of less than about 50 square kilometers. As noted in Section III.A.4, the concentration of any of the various types of hydrocarbons in the water column generally are quite low or below detection limits. In addition, the total organic compounds in the sediments of Cook Inlet are present in concentrations that indicate an unpolluted environment with no indication of an anthropogenic increase since start of oil development in Cook Inlet. The hydrocarbons are transitory in the water column and not in evidence in the sediments.

IV.B.1.a(4)(c) Oil Spills Greater than or Equal to 1,000 Barrels

Our data indicate that for Alternative I, a spill of a thousand barrels or greater is unlikely to occur, and no such spill would result from the Alternative I scenario. However, for the purpose of analysis, we do evaluate what the effects of such a spill could be.

At the end of 3 days, the estimated characteristics of a typical platform (1,500-barrel) or pipeline (4,600-barrel) spill greater than 1,000 barrels include: (1) a discontinuous surface area extending over an estimated 31-56 square kilometers; (2) about 2-13% % of the volume spilled dispersing into the water column; (3) about 25-27 % evaporated; and (4) 59-74% of the volume originally spilled remaining in the slick (Section IV.A.1). Based on the assumptions above for smaller spills, and, depending on the size, ice cover, and season of spillage, we estimate the concentration of dispersed oil after 3 days to range between 34-410 parts per billion over the top 5 meters of the water column. After 10 days, the discontinuous slick would extend over an estimated 77-265 square kilometers, 4-39% of the oil in the spill would be dispersed into the water column, and the amount of oil remaining in the slick would be about 30-66% of the spilled volume. We estimate the concentration of oil dispersed into the water at 10-103 parts per billion over a dispersal depth of 10 meters. After 30 days, the discontinuous slick would extend over 618-1,100 square kilometers, 12-62% of the oil in the spill would be dispersed into the water column, and the amount of oil remaining in the slick would be about 5-52% of the spilled volume. We estimate the concentration of oil dispersed into the water at 1.7-11.7 parts per billion over a dispersal depth of 30 meters.

The highest dispersed oil concentrations would be for a winter spill in open water, with lowest concentrations for either a winter spill in ice cover or a summer spill. These concentrations overlap the 15 parts per billion total hydrocarbon chronic criterion but are less than the 1,500 parts per billion acute criterion. The concentration of dispersed oil in the water greater than the chronic criterion of 15 parts per billion would persist more than 10 days but less than 30 days before dilution and other hydrodynamic processes reduced dispersed oil concentrations below 15 parts per billion. These hydrodynamic processes act to continuously reduce the concentrations. Other processes that degrade oil and remove it from the water column such as sedimentation and biodegradation occur, but they are too difficult to quantify to include in the simplified concentration estimates.

As noted in the discussion in the preceding section regarding dilution rates of dispersed oil from small spills, dilution rates may be more rapid than are indicated by the estimates calculated in this section for large spills. Dilution in a mixing zone of some of the substances dissolved or suspended in discharges from petroleum, exploration, and drilling units or production platforms could range from about 1,000:1 to 1,000,000:1.

The concentrations of oil associated with estimating dispersal in the water column in this section are conservative and overlap the measured concentrations found in much larger real spills. For comparison, the measured concentration of oil (1) from the *Argo Merchant* (National Research Council, 1985) spill ranged from 90-170 parts per billion at the surface and up to 340 parts per billion in the water column (at several of the sampling stations, the concentrations were uniform to a water depth of 20 meters) and (2) from the *Amoco Cadiz* (Gundlach et al., 1983) spill ranged from 2-200 parts per billion in the nearshore area and 30-500 parts per billion in the estuaries. The *Argo Merchant* and *Amoco Cadiz* spills (National Research Council, 1985) were much larger; 0.18 and 1.6 million barrels, respectively, than is the assumed 1,500-4,600-barrel spill for the Sale 191 analysis.

Summary of the Effects of a Large Oil Spill (Greater than or Equal to 1,000 Barrels) on Cook Inlet Water Quality. A large oil spill (greater than or equal to 1,000 barrels) would not significantly degrade the quality of Cook Inlet water. Concentrations of hydrocarbons in water would be less than the acute criterion within 3 days of spillage and concentrations above the chronic criterion would persist less than 30 days.

IV.B.1.a(5) Large Natural Gas Release

An accidental release of natural gas from a gas-well blowout or pipeline rupture is not expected to have measurable effects on Cook Inlet water quality.

IV.B.1.a(6) Construction Activities

The construction activities that potentially could affect the water quality in Cook Inlet would be associated with laying on the seafloor a trunk pipeline used to transport oil from the production platform to the shore (Appendices B and G). For Alternative I, we assume 25-mile (40-kilometer) oil and gas pipelines would be used to transport oil from the production platform to shore. Oil-pipeline laying would occur in the years 2010-2011 and gas pipeline laying in 2022. The suspended-particulate matter concentration in the waters of lower Cook Inlet range from about 1-50 milligrams per liter and consists, in part, of particulate matter resuspended by tidal currents and wind-driven waves and currents. The concentration of resuspended particulate matter in the water column from pipeline-laying operations may be greater than the natural suspended-particulate matter concentration downcurrent from the operations. However, the turbulence caused by the tidal and other currents will dilute the concentrations of the resuspended particulates; the ratios of dilution could range from 10,000:1 to 1,000,000:1 within 100-200 meters downcurrent of the pipeline-laying operations. Construction activities are not expected to degrade Cook Inlet water quality.

IV.B.1.a(7) Difference in Effects of Sale 199 Compared to Sale 191

Because we estimate that only one platform would result from either or both sales, the effects of Sale 199 or Sale 191 plus Sale 199 would be essentially the same as for Sale 191 alone except for possibly being delayed. The single oil and gas platform under either or both sale scenarios have identical impacting factors such as production volume, number of wells, number of pipelines, and pipelines lengths. Either or both sales together would not be expected to cause any significant degradation of Cook Inlet water quality.

IV.B.1.a(8) Effectiveness of Mitigation Measures

None of the proposed mitigating measures (see Section II.F) would decrease the already low estimated effect on water quality. The transportation of hydrocarbons indicates, but does not require a preference for, pipelines over tankers. The Alternative I scenario already assumes that pipelines will be used to transport oil and gas production. The Information to Lessee (ITL) clause for oil-spill-response preparedness only identifies the existing requirements for an oil-spill-contingency plan that must be met before postlease exploration, development, or production can proceed. This analysis already assumes that MMS regulations will be followed. The information in ITL No. 6 – Drilling Fluids and Cuttings Discharge during Post-Lease Activities provides what is already common knowledge and what has been elaborated on by the Environmental Protection Agency in their development of and public hearings and press releases on both the current oil and gas general NPDES permit and the Osprey NPDES permits in Cook Inlet. This analysis assumes that development and production wastes will not be discharged.

IV.B.1.a(9) Summary

The activities associated with petroleum exploitation are not likely to significantly affect water quality for Sale 191. A large oil spill (greater than or equal to 1,000 barrels) would not significantly degrade the quality of Cook Inlet water. Concentrations of hydrocarbons in water would be less than the acute criterion within 3 days of spillage, and concentrations above the chronic criterion would persist less than 30 days. However, a large oil spill is unlikely to occur. Drilling fluids and produced waters are not anticipated to be discharged during production. The remaining affecting activities—exploration discharges, small spills, and construction activities—also would not significantly affect water quality. The hydrodynamic processes in the Cook Inlet Planning Area suggest the water column generally is well mixed, and dilution would reduce the concentration of the substances in the discharges. Degradation processes also act to continuously reduce the concentrations of many substances deliberately or accidentally released into the environment.

We do not expect the discharge of drilling muds and cuttings and other discharges associated with exploration drilling to have any effect on the overall quality of Cook Inlet water. Within a distance of between 100 and 200 meters from the discharge point, the turbidity caused by suspended-particulate matter in the discharged muds and cuttings would dilute to levels that are less than the chronic criteria (100-1,000 parts per million) and within the range associated with the variability of naturally occurring suspended-particulate matter concentrations. Mixing in the water column would reduce the toxicity of the drilling muds that already fall into the “practically nontoxic” category to levels that would not be harmful to organisms in the water column. In general, the amounts of additives in the other discharges are likely to be relatively small (from 4 to 400 or 800 liters/month and diluted with seawater several hundred to several thousand times before being discharged into the receiving waters. The potential effects in any of the areas where there are permitted discharges would last for about 3-4 months for each exploration well drilled.

Produced waters from a Sale 191 production platform likely would be injected into underlying formations. Even if discharged, we estimate that produced waters would not degrade the quality of Cook Inlet water.

The routine other discharges associated with oil production would not cause any overall degradation of Cook Inlet water quality.

We estimate that small oil spills, as represented in this analysis by 5- and 160-barrel spills, would not have any degradational effects on the overall water quality of Cook Inlet. The small spills would degrade the water quality for a relatively short period of time, perhaps up to about 10 days, in areas of less than about 50 square kilometers. As noted in Section III.A.4, the concentration of any of the various types of hydrocarbons in the water column generally are quite low or below detection limits. Also, the total organic compounds in the sediments of Cook Inlet are present in concentrations that indicate an unpolluted environment with no indication of an anthropogenic increase since start of oil development in Cook Inlet. The hydrocarbons are transitory in the water column and not in evidence in the sediments.

A large oil spill (greater than or equal to 1,000 barrels) would degrade the quality of Cook Inlet water for a period of less than 30 days in an area up to 1,000 square kilometers. The hydrocarbon concentration in the water column above the acute criterion (1,500 parts per billion) would persist less than 3 days. The hydrocarbon concentration may remain greater than the chronic criterion (15 parts per billion) for less than a month. Accidental natural gas releases will have no measurable effect on water quality.

Construction activities would increase the turbidity in the water column along segments of the 40-kilometer corridors for up to a few months, but no significant water quality degradation would occur.

IV.B.1.b. Effects of Sale 191 on Air Quality

General Areawide Discussion. This discussion analyzes the potential impacts on air quality that could be caused by the activities and developments induced by each of the two lease sales for the Cook Inlet Planning Area. Impacts to air quality would result from discharges (air emissions). Because disturbances and noise do not cause air-quality impacts, they are not discussed further. Supporting materials and discussions are presented in Section III.A.5 (description of existing air quality in Cook Inlet). Mitigation of adverse air-quality impacts would result from operators' use of the best available technology to control discharges according to Environmental Protection Agency and State of Alaska pollution-control standards. None of the standard or proposed stipulations and ITL clauses is particularly applicable to air-quality impacts.

The type and relative amounts of air pollutants generated by offshore operations vary according to the phase of activity. The three principal phases are exploration, development, and production. For a more detailed discussion of emission sources associated with each phase, refer to Air Quality Impact of Proposed OCS Lease Sale No. 95 (Jacobs Engineering Group, Inc., 1989). Significant emission sources are summarized in Sections IV.B.1.b(2) and IV.B.1.b(3).

Air pollutants discussed include nitrogen oxides, carbon monoxide, sulfur dioxide, particulate matter, and volatile organic compounds. Ozone is not emitted directly by any source but is formed in a series of complex photochemical reactions in the atmosphere involving volatile organic compounds and nitrogen oxides.

Nitrogen oxides consist of both nitric oxide and nitrogen dioxide. The nitrogen oxides are formed from the oxygen and nitrogen in the air during combustion processes, and the rate of the formation increases with combustion temperature. Nitric oxide, the major component of the combustion process, will slowly oxidize in the atmosphere to form nitrogen dioxide; nitrogen dioxide and volatile organic compounds perform a vital role in the formation of photochemical smog. Nitrogen dioxide breaks down under the influence of sunlight, producing nitric oxide and atomic oxygen, which then combine with diatomic oxygen to form ozone or with volatile organic compounds to form various gaseous and particulate compounds that result in the physiological irritation and reduced visibility typically associated with photochemical smog.

Carbon monoxide is formed by incomplete combustion. It is a problem mainly in areas having a high concentration of vehicular traffic. High concentrations of carbon monoxide present a serious threat to human health because they greatly reduce the capacity of the blood to carry oxygen.

Sulfur dioxide is formed in the combustion of fuels containing sulfur. In the atmosphere, sulfur dioxide slowly converts to sulfate particles. Sulfates in the presence of fog or clouds may produce sulfuric-acid mist. It is generally recognized that entrainment of sulfur oxides or sulfate particles into storm clouds is a major contributor to the reduced pH levels observed in acid rain precipitation.

Emissions of particulate matter associated with combustion consist of particles in the size range less than 10 microns in diameter. Emissions of particulate matter associated with combustion, especially particles in the size range of 1 to 3 microns, can cause adverse health effects. Particulates in the atmosphere also tend to reduce visibility.

Air-Quality Regulations and Standards. Federal and State statutes and regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods (see Table III.A-20). These maxima are designed to protect human health and welfare. However, one exceedance per year is allowed, except for standards based on an annual averaging period. The standards also include Prevention of Significant Deterioration provisions for nitrogen dioxide, sulfur dioxide, and particulate matter less than 10 microns in diameter (PM_{10}) to limit deterioration of existing air quality that is better than that otherwise allowed by the standards (an attainment area). Maximum allowable increases in concentrations above a baseline level are specified for each Prevention of Significant Deterioration pollutant. There are three classes (I, II, and III) of Prevention of Significant Deterioration areas. Class I, the most restrictive, which applies to certain national parks, monuments, and wilderness areas, allows the least degradation and restricts degradation of visibility. That portion of the Tuxedni National Wildlife Refuge designated as a National Wilderness Area is the only Class I area adjacent to the Cook Inlet multiple-sale area. The remaining areas adjacent to the sale area are Class II, which allows a moderate incremental decrease in the air quality of the area. Before issuing air quality permits, the Environmental Protection Agency and the State of Alaska establish for each location Baseline Prevention of Significant Deterioration pollutant concentrations and the portion of the Prevention of Significant Deterioration increments already consumed. Air-quality standards do not directly address all other potential effects, such as acidification of precipitation and freshwater bodies or effects on nonagronomic plant species.

With the enactment of the Clean Air Act Amendments of 1990, the Environmental Protection Agency has jurisdiction for air quality over the Cook Inlet program area. Lease operators must comply with that agency's requirements for OCS sources, including the provisions of Title I, Part C, of the Clean Air Act (Prevention of Significant Deterioration of Air Quality). Section 328 states that for a source located within 25 miles of the seaward boundary of a State (such as the entire Cook Inlet multiple-sale proposal area), requirements would be the same as those that would apply if the source were located in the corresponding onshore area.

Air-Quality Modeling. Much air-quality modeling has been done for the Cook Inlet multiple-sale proposal. Results of the current modeling show that the highest pollutant concentrations would be from nitrogen dioxide, and that the concentrations would be well within the Prevention of Significant Deterioration limits and air quality standards, even for the wilderness portion of the Tuxedni National Wildlife Refuge subject to the strict Class I Prevention of Significant Deterioration limits. Potential air-quality impacts associated with the proposed Cook Inlet lease sales were estimated using the Offshore and Coastal Dispersion (OCD5) model (Herkhof, 2002). Because this reference is an unpublished document, we have added it to this EIS as Appendix H.

IV.B.1.b(1) Conclusion

Effects on onshore air quality from air emissions likely would be only a very small percent of the maximum allowable Prevention of Significant Deterioration Class II increments and only a small percent of the Class I increments where they apply. The concentrations of criteria pollutants in the onshore ambient air would remain well within the air-quality standards. Consequently, it is estimated there would be only a minimal effect on air quality with respect to standards. Principally, because of the distance of emissions from land, the other effects of air-pollutant concentrations at the shore due to exploration, development, and production activities, or accidental emissions, would not be sufficient to harm vegetation. A light, short-term coating of soot over a localized area could result from oil fires.

The air-quality analysis is based on the specific emission controls and emission limitations that the operators would apply to meet the appropriate Environmental Protection Agency regulations and permit requirements for any development and production activities. The effects of all these activities would cause *only small, local, temporary increases in the concentrations of criteria pollutants. Concentrations would be within the Prevention of Significant Deterioration Class II limits (and Class I limits where they apply) and National Ambient Air Quality Standards. Therefore, effects on air quality from the proposed sale would be low.*

IV.B.1.b(2) Effects from Exploration

For the exploration phase, emissions would be produced by (1) vessels used in gathering seismic and other geological and geophysical data; (2) diesel power-generating equipment needed for drilling exploratory and delineation wells; (3) tugboats, supply boats, and crew boats in support of drilling activities; and (4) intermittent operations such as mud degassing and well testing. Pollutants generated primarily would consist of nitrogen oxides (these would consist of nitric oxide and nitrogen dioxide; ambient air standards are set only for nitrogen dioxide), carbon monoxide, and sulfur dioxide. For each of the two proposed sales, we assume that exploration activity would begin in the year following that sale. Emissions from exploration would be from seismic surveys and from drilling four exploration wells and three delineation wells from one rig. Please see the Exploration and Development Scenario in Appendix B of this EIS for more details.

If a blowout (very unlikely) should occur from shallow gas encountered during exploratory drilling, it could be in the range of 5- to 10-million cubic feet per day, lasting probably no more than 1 day. The gas would ignite and burn until the gas flow ceased. Please see the following subsection b(3)(c) for a more detailed discussion of the effects from a large gas release.

During exploration, a very low probability oil spill could occur. This would release volatile organic compounds into the air, but these compounds would evaporate almost completely within a few hours. Please see subsection b(3)(b) for a detailed discussion of the effects on air quality of large (greater than 1,000 barrels) oil spills. Because we conclude there that the air-quality effects of any such large spills would be minimal, we estimate that the effects on air quality from any exploration spills would be insignificant.

Potential air-quality impacts associated with the proposed Cook Inlet lease sales were estimated using the Offshore and Coastal Dispersion model (Herkhof, 2002). The highest potential impacts on the Tuxedni National Wilderness Area Prevention of Significant Deterioration Class I area were simulated in the model by placing emission sources from projected outer continental shelf activities in the northwestern corner of the proposed multiple-sales area. Three years of meteorological data from the Homer, Alaska, National Weather Service station were used in the Offshore and Coastal Dispersion model. Upper-air data were obtained from the Anchorage radiosonde site.

The highest predicted annual average nitrogen dioxide concentration in the Tuxedni National Wilderness Area was 0.27 micrograms per cubic meter. This is well within the maximum allowable Prevention of Significant Deterioration Class I increment of 2.5 micrograms per cubic meter. The highest annual, 24-hour, and 3-hour average sulfur dioxide concentrations were 0.02, 0.58, and 2.7 micrograms per cubic meter, respectively. The corresponding maximum allowable Prevention of Significant Deterioration Class I increments are 2, 5, and 25 micrograms per cubic meter. The highest annual and 24-hour average PM_{10} concentrations were 0.02 and 0.51 micrograms per cubic meter. The corresponding maximum allowable Prevention of Significant Deterioration Class I increments are 4 and 8 micrograms per cubic meter. The highest annual nitrogen dioxide concentrations, highest 24-hour and 3-hour average sulfur dioxide concentrations, and highest 24-hour average PM_{10} concentrations exceed the significance levels prescribed by the Federal Land Manager for Prevention of Significant Deterioration Class I areas. The Class I significance levels are 0.03 micrograms per cubic meters for the annual average nitrogen dioxide, 0.07 micrograms per cubic meter for the maximum 24-hour average sulfur dioxide, 0.48 micrograms per cubic meter for the maximum 3-hour average sulfur dioxide, and 0.27 micrograms per cubic meter for the maximum 24-hour average PM_{10}.

If the projected emissions from a proposed facility exceed 250 tons per year, the operator would be required to apply to the Environmental Protection Agency for a Prevention of Significant Deterioration permit. This would involve an air-quality impact analysis using a regulatory air quality model. In addition, if the proposed facility is located within 100 kilometers (62 miles) of the Class I area, the project would be reviewed by the Fish and Wildlife Service. The Fish and Wildlife Service would evaluate the proposal in terms of the Prevention of Significant Deterioration Class I increments as well as impacts of air quality related values, including effects on visibility. If the predicted pollutant concentrations exceed any of the Class I significance levels, an increment consumption analysis would be required. This analysis would include any other emission sources in the area that could contribute to the consumption of the maximum allowable increases in concentration. Such a cumulative analysis would not be appropriate during the pre-lease stage because of the lack of site-specific information at this time.

The impacts on the Tuxedni National Wilderness Area are estimated to be lower than those predicted by the model. Most of the lease blocks offered in the proposed lease sales are located to the south of the Tuxedni National Wilderness Area, while the prevailing winds in the upper Cook Inlet tend to be northerly, according to meteorological data from the Drift River Terminal Coastal-Marine Automated Network (C-MAN) station. We estimate northerly winds to prevail around the Tuxedni National Wilderness Area due to the very high topography just to the west.

The VISCREEN visibility-screening model was applied to assess potential impacts to visibility in the Tuxedni National Wilderness Area. For an exploration project located 12 kilometers (7.5 miles) distant from the Tuxedni National Wilderness Area, the model results exceed the screening criteria for the situation where the wind blows directly from the facility to the observer, a 1 meter (3.28 feet) per second wind speed, and stable atmospheric conditions. If the screening criteria are exceeded, it indicates the possibility that a plume generated by the emissions would be visible by an observer within Tuxedni. It does not provide a measure of any general visibility effects in the area, such as regional haze. We estimate this scenario to occur less than 1% of the time. For distances larger than 50 kilometers (31 miles), the screening criteria were not exceeded. Under average meteorological conditions, we estimate that a plume would not be visible.

Applicants for air quality permits would need to analyze not only their proposed project's direct visibility impacts but also the combination of those impacts with the impacts of regional haze originating, at least in part, from oil platforms and other industrial facilities in upper Cook Inlet.

Highest predicted pollutant concentrations on Class II areas would be similar to those predicted for the Tuxedni Class I area. The maximum allowable increases are higher than those for a Class I area, so the pollution concentrations would be well within the Prevention of Significant Deterioration limits.

IV.B.1.b(3) Effects from Development and Production

IV.B.1.b(3)(a) Effects from Routine Operations

IV.B.1.b(3)(a)1) Development Phase

The development phase includes activities associated with platform installation, pipeline installation, drilling of production wells, and production. Highest emissions would occur during the construction phase; emissions would be lower once the facilities are in place and production begins. During platform installation and commissioning activities, impacts would be similar to those predicted for the exploration phase.

For the development phase, including temporary construction operations and drilling, the main sources of emission offshore would be the following:

- piston-driven engines or gas turbines used to provide power for drilling;
- heavy construction equipment used to install platform and pipelines;
- construction and commissioning support equipment, including cranes, pumps, generators, compressors, pile drivers, welders, heaters, and flare;
- tugboats needed to move equipment and supply barges and support vessels.

Peak-year emissions from development would include those generated during platform and pipeline installation and the drilling of 16 production wells from one rig. For all these operations, the best available control technology would be applied under the Environmental Protection Agency's air-quality regulations. The main emissions would be nitrogen oxides, with lesser amounts of sulfur dioxide, carbon monoxide, and particulate matter. Once in the atmosphere, nitric oxide gradually converts to nitrogen dioxide.

IV.B.1.b(3)(a)2) Production Phase

For the production phase, the main source of offshore emissions would be from turbines for power generation and gas compression, and from power generation for oil pumping and water injection. Peak-year production emissions would result from operations producing 18.3 million barrels of oil and 18.4 billion cubic feet of gas and transportation of those products. The emissions would consist mainly of nitrogen oxides, with smaller amounts of carbon monoxide and particulate matter. Another source of emissions would be evaporative losses of volatile organic compounds from oil/water separators, pump and compressor seals, and valve packing; using seal systems designed to reduce emissions would minimize these evaporative losses. Produced-water and slop-oil tanks would be equipped with a vapor-recovery system, which would recover emissions of volatile organic compounds from these tanks and return them to the process. Operators would probably have a flare available 24 hours a day, 365 days a year. During oil production, we anticipate that there could be some small (less than 1,000 barrels) accidental oil spills. These would release volatile organic compounds into the air, but these compounds would evaporate almost completely within a few hours. Please see subsection b(3)(b) for a detailed discussion of the effects on air quality of large (greater than 1,000 barrels) oil spills. Because we conclude there that the air quality effects of any such large spills would be minimal, we estimate that the effects on air quality from any small spills would be insignificant. Unlike oil spills, small amounts of gas may be released, and usually flared, as part of the routine, permitted operations. In addition, during oil production, separation of solution gas from oil occurs on the platform. In case of malfunction or emergency, processing would shut down, limiting the release, and the gas would most likely be flared. If there were venting (unexpected), it would emit volatile organic compounds. However, flaring largely would burn up any emissions of volatile organic compounds, and they should not create a pollution problem. Flaring would produce mostly some nitrogen oxides, sulfur dioxide, particulate matter, and carbon monoxide. Flaring would probably produce only a very small amount of sulfur dioxide because we estimate that sulfur in the produced gas should be very low (but never completely absent).

During sales gas production (after 2022), we assume that a blowout of a single well on the platform would release 10 million cubic feet of natural gas for one day. The rupture of a gas pipeline would result in a short-term release of gas. The gas would ignite and burn until the gas flow ceased. A sudden decrease in gas pressure automatically would initiate procedures to close those valves that would isolate the ruptured section of the pipeline and thus prevent a further escape of gas. Please see the following subsection b(3)(c) for a more detailed discussion of the effects from a large gas release.

For the peak production years, the highest predicted annual average nitrogen dioxide concentration in the Tuxedni National Wilderness Area was 0.10 micrograms per cubic meter. This is well within the maximum allowable Prevention of Significant Deterioration Class I increment of 2.5 micrograms per cubic meter. The highest annual, 24-hour, and 3-hour average sulfur dioxide concentrations were 0.00, 0.04, and 0.10 micrograms per cubic meter, respectively. The corresponding maximum allowable Prevention of Significant Deterioration Class I increments are 2, 5, and 25 micrograms per cubic meter. The highest annual and 24-hour average PM_{10} concentrations were 0.01 and 0.12 micrograms per cubic meter. The corresponding maximum allowable Prevention of Significant Deterioration Class I increments are 4 and 8 micrograms per cubic meter. The highest annual nitrogen dioxide concentration exceeds the Prevention of Significant Deterioration Class I significance level of 0.03 micrograms per cubic meter. All other pollutant concentrations had values that were below the Class I significance levels.

If the projected emissions from a proposed facility exceed 250 tons per year, the operator would be required to apply to the Environmental Protection Agency for a Prevention of Significant Deterioration permit. The steps involved in this process are the same as those described under the exploration phase. As discussed earlier, the impacts on the Tuxedni National Wilderness Area are estimated to be lower than those predicted by the model because of the locations of the lease blocks in relation to the prevailing winds.

The VISCREEN visibility-screening model was applied to assess potential impacts to visibility in the Tuxedni National Wilderness Area. For a production facility located 12 kilometers (7.5 miles) distant from the Tuxedni National Wilderness Area, the model results exceed the screening criteria for the situation where the wind blows directly from the facility to the observer, a 1-meter- (3.28-foot-) per second wind speed, and stable atmospheric conditions. If the screening criteria are exceeded, it indicates the possibility that a plume generated by the emissions would be visible by an observer within Tuxedni National

Wilderness Area. It does not provide a measure of any general visibility effects in the area (regional haze). We estimate this scenario to occur less than 1% of the time. For distances of about 30 kilometers (19 miles) and greater, the screening criteria were not exceeded. Under average meteorological conditions, we would not expect a plume to be visible.

Highest predicted pollutant concentrations on Class II areas would be similar to those predicted for the Tuxedni Class I area. The maximum allowable increases are higher than those for a Class I area, so the pollution concentrations would be well within the Prevention of Significant Deterioration limits.

IV.B.1.b(3)(a)3) Additional Discussion of Emissions

Abandonment of facilities developed after the proposed sales would cause more heavy equipment operations than during the production phase of operations, but effects probably would be quite similar to the construction portion of the development phase of operations. Because abandonment operations would last perhaps a maximum of 10-15% of total operations time and would include no activities that should affect air quality more significantly than previously discussed, we conclude that these operations would cause insignificant effects on air quality.

Other sources of pollutants related to OCS operations are accidents such as blowouts and oil spills; these are discussed above. Typical emissions from such accidents consist of hydrocarbons (volatile organic compounds); only fires associated with blowouts or oil spills produce other pollutants.

IV.B.1.b(3)(a)4) Other Effects on Air Quality

Other effects of air pollution from OCS activities and other sources on the environment not specifically addressed by air-quality standards include the possibility of damage to vegetation, acidification of coastal areas, and atmospheric visibility impacts. Effects may be short term (hours, days, or weeks), long term (seasons or years), regional (Cook Inlet Basin), or local (nearshore only). Visibility may be defined in terms of visual range and contrast between plume and background (which determines perceptibility of the plume).

A significant increase in ozone concentrations onshore is not estimated to result from exploration, development, or production scenarios associated with the Proposal. Photochemical pollutants such as ozone are not emitted directly; they form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is often present in the Cook Inlet Planning Area, temperatures are rarely very high. In addition, activities occurring because of field development are offshore and separated from each other, diminishing the combined effects from these activities and greatly increasing atmospheric dispersion of pollutants before they reach shore.

Olson (1982) reviewed susceptibility of fruticose lichen, an important component of the coastal tundra ecosystem, to sulfurous pollutants. There is evidence that sulfur dioxide concentrations as low as 12.0 micrograms per cubic meter for short periods can depress photosynthesis in several lichen species, with damage occurring at 60 micrograms per cubic meter. In addition, the sensitivity of lichen to sulfate is increased in the presence of humidity or moisture, conditions that are common on coastal tundra. However, because of the small size and number of sources of sulfur dioxide emissions, the ambient concentrations at most locations may be assumed to be near the lower limits of detectability. Because of the distance of the proposed activities from shore, attendant atmospheric dispersion, and low existing levels of onshore pollutant concentrations, we estimate the effect on vegetation under the multiple-sale proposal to be minimal.

IV.B.1.b(3)(b) Effects from Large Oil Spills

IV.B.1.b(3)(b)1) Details on How an Oil Spill May Affect Air Quality

The MMS estimates the chance of a large spill greater than or equal to 1,000 barrels0 occurring and entering offshore waters to be 19% over the life of the project. For purposes of analysis, we model one large spill of either 1,500 barrels (platform spill) or 4,600 barrels (pipeline spill). Based on modeling work by Hanna and Drivas (1993), it is estimated that the volatile organic compounds from offshore facility or pipeline oil spills would evaporate almost completely within a few hours after the spill occurred. The article cited discusses the rate or evaporation and ambient concentrations of 15 different volatile organic compounds. Several of these compounds, such as benzene, ethylbenzene, toluene, and n-xylenes, are classified by the Environmental Protection Agency as hazardous air pollutants. The study results showed that these compounds evaporate almost completely within a few hours after the spill occurs. Ambient concentrations peak within the first several hours after the spill starts and are reduced by two orders of magnitude after about 12 hours. The heavier compounds take longer to evaporate and may not peak until about 24 hours after spill occurrence. Total ambient volatile organic compound concentrations are significant in the immediate vicinity of an oil spill, but concentrations are much reduced after the first day. In the event of an oil spill on land such as could occur from an onshore pipeline spill, the air quality effects would be less severe than offshore (because some of the oil could be absorbed by vegetation or into the ground), but some effects might last longer before the volatile organic compounds were completely dissipated.

Diesel fuel oil could be spilled either while being transported or from accidents involving vehicles, vessels, or equipment. A diesel spill would evaporate faster than a crude oil spill. Ambient hydrocarbon concentrations would be higher than with a crude oil spill but would persist for a shorter time. In addition, because any such spill probably would be smaller than some potential crude oil spills, it is estimated that any air-quality effects from a diesel spill would be even lower than for other spills.

Over the life of oil exploration, development, and production in the sale area, an oil spill could be set on fire accidentally or deliberately. Potential contamination of the shore would be limited because exploration and development and production activities under the Proposal would be at least 4.8 kilometers (3 miles) offshore, with the exception of any oil- or gas-transport pipelines. In addition, large fires create their own local circulating winds—toward the fire at ground level—that affect plume motion. Accidental emissions would have an estimated minimal effect on onshore air quality.

Oil or gas blowouts may catch fire. In addition, in situ burning is a preferred technique for cleanup and disposal of spilled oil. For catastrophic oil blowouts, in situ burning may be the only effective technique for spill control. Please see subsection b(3)(b)2) for a discussion of in situ burning. Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99.98% and very slightly increase emissions of other pollutants. If an oil spill were ignited immediately after spillage, the burn could combust 33-67% of crude oil or higher amounts of fuel oil (diesel) that otherwise would evaporate. On the other hand, incomplete combustion of oil would inject about 10% of the burned crude oil as oily soot, and minor quantities of other pollutants, into the air. In situ burning would be less effective in areas of broken ice than in open water, but it would still reduce the effects of volatile organic compounds on the ambient air quality. We consider that the probability of any blowout from the proposed lease sale is extremely low.

For a major oil blowout, setting fire to the wellhead could burn 85% of the oil, with 5% remaining as residue or droplets in the smoke plume in addition to the 10% soot injection (Evans et al., 1987). (Table IV.B.12-4 in the Sale 144 final EIS [USDOI, MMS, Alaska OCS Region, 1995] shows calculated emissions from burning crude oil.) Clouds of black smoke from a burning 360,000-barrel oil spill 75 kilometers (47 miles) off the coast of Africa locally deposited oily residue in rainfall 50-80 kilometers (31-50 miles) inland. Later the same day, clean rain washed away most of the residue and allayed fears of permanent damage.

Based on qualitative information, burns that are two or three orders of magnitude smaller do not appear to cause noticeable fallout problems. Along the TAPS, 500 barrels of a spill were burned over a 2-hour period, apparently without long-lasting effects (Schulze et al., 1982). The smaller volume Tier II burns at Prudhoe Bay had no visible fallout downwind of the burn pit (Industry Task Group, 1983a).

Soot is the major contributor to pollution from a fire. This soot, which would cling to plants near the fire, would tend to slump and wash off vegetation in subsequent rains, limiting any health effects. Coating portions of the ecosystem in oily residue is the major, but not the only, potential air-quality risk. Recent examination of polycyclic aromatic hydrocarbons in crude oil and smoke from burning crude oil indicates that the overall amounts of polycyclic aromatic hydrocarbons change little during combustion, but the kinds of polycyclic aromatic hydrocarbon compounds present do change. Benzo(a)pyrene, which is often used as an indicator of the presence of carcinogenic varieties of polycyclic aromatic hydrocarbons, is present in crude-oil smoke in quantities approximately three times larger than in the unburned oil. However, the amount of polycyclic aromatic hydrocarbons is very small (Evans, 1988). Investigators found that, overall, the oily residue in smoke plumes from crude oil is mutagenic but not highly so (Sheppard and Georghiou, 1981; Evans et al., 1987). The Expert Committee of the World Health Organization considers daily average smoke concentrations of greater than 250 micrograms per cubic meter to be a health hazard for bronchitis.

Because of the distance from shore (at least 4.8 kilometers, or 3 miles) and the dispersal of airborne pollutants by winds, accidental emissions likely would have a minimal effect on onshore air quality.

IV.B.1.b(3)(b)2) Effects of Oil-Spill-Cleanup Activities on Air Quality

In situ burning as part of a cleanup of spilled crude oil or diesel fuel would temporarily adversely affect air quality, but the effects would be low. For much greater detail, see Fingas et al. (1995). Extensive ambient measurements were performed during two experiments involving the in situ burning of approximately 300 barrels of crude oil at sea. During the burn, carbon monoxide, sulfur dioxide, and nitrogen dioxide were measured only at background levels and were frequently below detection levels. Ambient levels of volatile organic compounds were high within about 100 meters (328 feet) of the fire, but were significantly lower than those associated with a nonburning spill. Measured concentrations of polycyclic aromatic hydrocarbons were found to be low, as it appeared that the burn consumed a major portion of these compounds. Effects of in situ burning for spilled diesel fuel would be similar to those associated with a crude oil spill.

Just as would happen in the case of a blowout (discussed in the preceding section), if an oil spill were ignited immediately after spillage, the burn could combust 33-67% of the crude oil or higher amounts of fuel oil that otherwise would evaporate. On the other hand, incomplete combustion of oil would inject about 10% of the burned crude oil as oily soot, and minor quantities of other pollutants, into the air.

Additional work published in an article by McGrattan et al. (1995) reported that smoke-plume models have shown that the surface concentrations of particulate matter do not exceed the health criterion of 150 micrograms per cubic meter beyond about 5 kilometers (3.1 miles) downwind of an in situ burn. This is quite conservative, as this health standard is based on a 24-hour average concentration rather than a 1-hour average concentration. This appears to be supported by field experiments conducted off Newfoundland and in Alaska (McGrattan et al., 1995).

Other air-quality effects from cleanup activities would include emissions from vessels, vehicles, and equipment used in the cleanup effort; these should be very low. Concentrations of criteria pollutants would remain well within Federal air-quality standards. The overall effects on air quality would be minimal.

IV.B.1.b(3)(b)3) Summary and Conclusion for Effects of an Oil Spill on Air Quality

In the unlikely event of a large oil spill from an offshore facility or pipeline, such a spill could cause a small, local increase in the concentrations of gaseous hydrocarbons (volatile organic compounds) due to evaporation from the spill. The volatile organic compound concentrations would be very low and normally be limited to only 1 or 2 square kilometers (0.4-0.8 square miles). During open-water conditions, spreading of the spilled oil and action by winds, waves, and currents would disperse the volatile organic compounds, so that they would be at extremely low levels (although over a relatively larger area). During broken sea ice or melting ice conditions, because of lesser dispersion of the oil, the concentrations might reach slightly higher levels for several hours, possibly up to 1 day. If a spill occurred under such broken-ice or melting conditions, some of the oil would be trapped and essentially remain unchanged until the ice began to melt or broke up further, releasing the trapped oil. Some of the volatile organic compounds also would be released from the oil and dispersed, even from under the ice. Furthermore, because of the extremely high tides and associated tidal currents in Cook Inlet, the broken ice itself would be dispersed and/or broken up rather quickly. In any of these situations, moderate or greater winds further would reduce the volatile organic compound concentrations in the air. Concentrations of criteria pollutants would remain well within Federal air-quality standards. The overall effects on air quality would be minimal.

IV.B.1.b(3)(c) Effects from Large Gas Releases

Sources of air pollutants related to OCS operations include accidental emissions resulting from gas or oil blowouts. The number of blowouts on the United States OCS, almost entirely gas and/or water, averaged 3.3 per 1,000 wells drilled from 1956 through 1982 (Fleury, 1983). Danenberger (1993) determined a frequency of 4.1 blowouts per 1,000 wells drilled from 1971 through 1991. Typical emissions from such accidents consist of hydrocarbons (volatile organic compounds); only fires associated with blowouts produce other pollutants, such as nitrogen oxides, carbon monoxide, sulfur dioxide, and particulate matter. It is estimated that accidental emissions would have little effect on onshore air quality.

A gas blowout could release 20 tons per day of gaseous hydrocarbons of which, about 2 tons per day would be nonmethane hydrocarbons classified as volatile organic compounds. The probability of experiencing one or more blowouts in drilling the wells projected for the Cook Inlet multiple-sale Proposal is estimated to be low. If a gas blowout did occur, it is estimated that it would not persist more than 1 day and that it would release less than 2 tons of volatile organic compounds. Since 1974, 60% of the blowouts lasted less than 1 day, and only 10% have lasted more than 7 days.

A gas or oil blowout might catch fire. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99.98% and very slightly increase emissions—relative to quantities in other oil and gas industrial operations—of other pollutants. (Table IV.B.12-3 in Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final EIS [USDOI, MMS, Alaska OCS Region, 1995] shows calculated emissions from burning 20 tons of natural gas per day during a blowout.)

IV.B.1.b(4) Difference in Effects from Sale 199 Alternative I Activities Compared to Sale 191 Alternative I Activities, if Any

Air-quality impacts are determined by atmospheric transport and dispersion patterns and the relative locations of the emission sources and receptors (points where impacts are evaluated). These characteristics will vary to some extent in different locations within Cook Inlet. Wind patterns are determined by large-scale circulation systems and by local topography and heat exchange between the atmosphere, ocean, and ice. Atmospheric dispersion patterns are very complex as well. Air-quality monitoring results for a project such as the Cook Inlet proposal are estimated to vary from one area to another, depending on local meteorological and topographical conditions. The air-quality modeling for OCS Sale 149 and the current modeling specifically for this Cook Inlet multiple-sale Proposal both predicted only small impacts. We can reasonably assume that the effects from facilities anywhere in the region would fall within the regulatory standards.

Because individual air masses move constantly with atmospheric circulation, we estimate that the major differences in effects of the different alternatives on air quality would be those in which specific geographic areas could be affected by air emissions. Because these emissions should nowhere be significant, other than in extremely localized areas, we conclude that neither deferral alternative to the Cook Inlet multiple-sale Proposal will result in significant effects different from or other than those discussed in Section IV.B.1.b. Air-quality effects of all activities under both sales and both deferral alternatives would cause only small increases in the concentrations of criteria pollutants. Concentrations would be within the Prevention of Significant Deterioration Class I (where applicable) and Class II limits and National Ambient Air Quality Standards. Therefore, effects from the Cook Inlet multiple-sale Proposal would be low.

Activities associated with Sale 199 would result in no significant differences in effects from those discussed in Section IV.B.1.b.

IV.B.1.b(5) Effectiveness of Mitigation Measures

The stipulations do not apply to air quality, and they would not alter the effects on air quality analyzed in Section IV.B.1.b.

IV.B.1.c. Effects of Sale 191 on Lower Trophic-Level Organisms

This section assesses the effects on the organisms that are described in Section III.B.1.

IV.B.1.c(1) Conclusion

Routine, anticipated activities during exploration, development, and production as a result of Sale 191 probably would not have measurable effects on local populations of lower trophic-level organisms. Similar impacts as a result of Sale 199 would cause effects of the same low magnitude about 2 years later. Regarding spills, Cook Inlet is unlike most OCS areas in that it is an estuary with surrounding shoreline. Even though large spills are unlikely, if they occur, the likelihood of contact with part of the shoreline is relatively high. We estimate that a 1,500-barrel production platform spill or a 4,600-barrel pipeline spill would contaminate 17-38 kilometers (10-24 miles) of shoreline, most likely in southwestern Cook Inlet or western Shelikof Strait. In contrast, the risk to intertidal habitats on the east side of Cook Inlet would be low; for example, if a spill occurred at a hypothetical production platform in the multiple-sale area at any time during the year, the probability of contact with Clam Gulch within 30 days would be less than 4%. In any areas affected by a spill and the likely responses to it, populations of intertidal organisms would be depressed measurably for about a year, and small amounts of oil could persist in shoreline sediments for a decade.

IV.B.1.c(2) Effects of Anticipated Exploration from Sale 191

This section examines the probable effects to lower trophic-level organisms from routine operations and to small spills as a result of anticipated exploration under Alternative I for Sales 191 and 199. During the hypothetical 4-year exploration phase of Sale 191 (2005-2009), two exploratory wells and three delineation wells would be drilled from a single drilling platform.

Seismic surveys for exploration might cover about 10 square miles per well or a total of about 63 square miles over a period of 4 years. The seismic activity would have negligible effect on lower trophic-level organisms, which generally have no air bladders as fish do. The previous Cook Inlet OCS Sale 149 also concluded that seismic activity associated with the base case was expected to have little or no effect on lower trophic-level organisms (USDOI, MMS, Alaska OCS Region, 1995:Section IV.B.1.b[1]).

Exploration in deep water probably would involve semisubmersible or floating drill rigs, but jackup rigs and bottom-founded rigs might be used in water less than 200 feet deep. As explained in the previous Cook Inlet EIS (USDOI, MMS, Alaska OCS Region, 1995:Section IV.B.1.b[3]), these drill rigs would have little effect on lower trophic-level organism communities in the sale area for two reasons: (1) the small area affected by the two anticipated platforms during 3 years after each sale and (2) the widespread distribution of benthic marine organisms in the sale area.

Permitted discharges would include an estimated 950 tonnes (metric dry weight) of drilling muds and 2,800 tonnes of drill cuttings during a 4-year period. Detailed information about their chemical composition and Environmental Protection Agency tests for toxicity is included Section IV.B.1.a - Water Quality. The water-quality section notes that these amounts of material are a fraction of the particulate matter that rivers discharge daily into Cook Inlet. The water-quality section and the previous Cook Inlet Sale 149 EIS point out that the discharges would become diluted rapidly as high as 1,000,000:1 with a distance of 200 meters of a platform, and there would be no effect on planktonic organisms, such as shrimp (Section IV.B.1.a(2)(c) and National Research Council, 1983). The drilling muds and cuttings that accumulate on the seafloor in relatively shallow water might affect some benthic organisms for a short period close to the discharge point (USDOI, MMS, Alaska OCS Region, 1995:Section IV.B.1.b[2]). This assessment confirms the conclusion of the previous one that the effect probably would be sublethal for adults and might be lethal for immature stages within 1,000 meters of platforms that were actively discharging (i.e., for a few months or about a generation for typical benthic organisms) drilling muds and cuttings. This assessment also confirms the conclusion in the water-quality section that mixing in the water column would reduce the toxicity of drilling muds to levels that would not be harmful to organisms in the water column. If drilling muds and cuttings were not discharged during exploration, this local effect would not occur.

Small oil spills (less than 1,000 barrels) probably would occur. Most of them would be very small (less than 10 barrels), and this assessment assumes that there might be three between 10 and 100 barrels in size under Alternative 1 (see Section IV.A.4.b). As explained in the water-quality section (IV.B.1.a), a larger spill up to 1,000 barrels could degrade the water quality for up to 10 days in areas up to 50 square kilometers (20 square miles). Such a spill probably would not have a measurable effect on planktonic organisms, as indicated by studies of the mysid shrimp *Mysidopsis* that are used commonly in water-quality toxicity studies (see Section IV.B.1.a(3)(c)5)). Recent laboratory studies by Shirley and Duesterloh (2002) and Duesterloh, Short, and Barron (2002) showed that the mortality/morbidity effects of ultraviolet radiation, which generally penetrates less than a couple of meters into turbid water such as found in Cook Inlet, is doubled by the presence of hydrocarbons. Even with a doubling of natural toxicity of oil in the presence of ultraviolet radiation, the effect of such small spills on natural plankton populations probably would be immeasurably small and temporary.

A few spills might be large enough and persist long enough to drift to shore. In contrast to the temporary effect of spills on pelagic organisms, the effect on intertidal and subtidal organisms probably would be longer but, because of the limited amount of shoreline that would probably be affected, would not present a significant risk to local populations. The previous Cook Inlet Sale 149 EIS concluded similarly that "small oil spills (an estimated total of 555 barrels) may adversely affect individual lower trophic-level organisms in areas immediately around the spills" but that "they are not expected to have perceptible effects on lower tropic-level organisms at the population level" (USDOI, MMS, Alaska OCS Region, 1995:Section IV.B.1.b(4)(a)). The persistence, effects, and risk to each portion of the Cook Inlet shoreline are discussed further in the following subsection on large oil spills.

In summary, the routine activities associated with exploration in upper Cook Inlet have not had a documented effect on lower trophic-level organisms. We expect that the routine activities associated with exploration from Sale 191 would be similar and expect no measurable effects on the local populations. There would be further NEPA review of any specific proposed exploratory operations.

IV. B.1.c(3) Effects of Anticipated Development

During the hypothetical 24-year (2009-2033) development and production phases under Alternative 1, one production platform probably would be installed, 50 miles of offshore pipeline would be laid, 60 production and service wells would be drilled, and an assumed total of 140 million barrels of oil would be produced.

IV.B.1.c(3)(a) Routine Operations

Seismic surveys might cover an additional 24 square kilometers (9 square miles) for a platform and 28 square kilometers (11 square miles) for a pipeline. Such seismic activity probably would not affect lower trophic-level organisms for the same reasons that were previously described.

Construction would involve installing an offshore platform and laying an offshore pipeline. These activities would affect benthic organisms in the immediate vicinity. Organisms in soft substrates (bivalves and polychaetes) would be adversely affected; however, platforms would add a hard substrate to the marine environment, providing additional habitat for marine plants and animals (for example, kelp and mussels) that require a hard substrate. Therefore, the overall effect of platform and pipeline installation would be to alter species diversity in a small area. We assume a pipeline landfall to the north of Anchor Point on the Kenai Peninsula, which would alter a few acres of intertidal habitat. This development would displace some coastal organisms but would have no measurable effect on local populations. The Stipulation on Protection of Biological Resources, which provides for surveys near special benthic habitats, would help to reduce the level of impact.

IV.B.1.c(3)(b) Large Oil Spills

The MMS estimates the chance of a large spill (greater than or equal to 1,000 barrels occurring and entering offshore waters to be 19% over the life of the project. For purposes of analysis, we model one large spill of either a 1,500-barrel platform spill or a 4,600-barrel pipeline spill. Specifically, we assume that a platform spill would occur within one of seven hypothetical launch areas in the lease area, and that a pipeline spill would occur along segments of a 25-mile pipeline route to a landfall on the Kenai Peninsula north of Kachemak Bay (Map A-4). The previous Cook Inlet assessment explained that oil slicks generally have little effect on organisms below the tidal zone, and that the effects on shallow subtidal and intertidal organisms are well documented (USDOI, MMS, Alaska OCS Region, 1995:Section IV.B.1.b(4)(b)). The updated spill model for this assessment provides the risk of contact with specific land segments and environmental resource areas, as explained in the following.

A 1,500-barrel or 4,600-barrel spill probably would drift over an area of 14-22 square miles (32-56 square kilometers) within 3 days (Tables A.1-3 through A.1-6). Such a surface slick might kill plankton in the surface layer, but probably very little would mix into subsurface waters or down below the shallow subtidal zone. The Cook Inlet Sale 149 Final EIS explained that the toxicity of a surface slick probably would decrease rapidly because of evaporation, dispersion, and dilution and have little effect on plankton (USDOI, MMS, Alaska OCS Region, 1995:Section IV.B.1.b(4)(a)). The water-quality section explains that hydrocarbon concentrations in the water column probably would be above the acute criterion (1,500 parts per billion) for less than 3 days. As previously noted, a recent study by Duesterloh, Short, and Barron (2002) showed that the mortality/morbidity effects of ultraviolet radiation near the water surface on zooplankton are doubled by the presence of hydrocarbons. Even if a surface slick killed all of the plankton over 3 days within 56 square kilometers, which equals about half the area of Augustine Island, the effect on plankton populations would not be measurable for long because of the rapid rate of production. Coastal phytoplankton and zooplankton populations are capable of doubling their respective biomasses within a few days and a couple weeks, as described in Section III.B.1.a. Furthermore, any effect on plankton would be difficult to measure outside of the immediate area of the spill because of the turbulence in Cook Inlet. Even in relation to the areas with high phytoplankton concentration near Kennedy Entrance and Kalgin Island (Figure III.B.1), the size of the surface slick would be relatively small. This assessment does not confirm the details of the previous assessment in the Cook Inlet Lease Sale 149 EIS, which assumed a 50,000-barrel spill that would cover 350 square miles (912 square kilometers) within 10 days (USDOI, MMS, Alaska OCS Region, 1995:Section IV.B.1(4)(a)). However, the previous assessment also concluded that toxic concentrations rarely persist in the water column for longer than a few days following a spill.

Cook Inlet is unlike most OCS areas in that it is an estuary with surrounding shoreline. Even though large spills are unlikely, if they occur, the likelihood of contact with part of the shoreline is relatively high. We estimate that a 1,500-barrel spill would contaminate 10-14 miles (17-23 kilometers) of coastline (Tables A.1-3 and A.1-4), and a 4,600-barrel spill would contaminate 17-24 miles (28-38 kilometers) (Table A.1-5 and A.1-6). The coastline most likely would be contacted on the western side of Cook Inlet if the spill occurred in the northern or central parts of the proposed lease area, especially during the winter (Tables A.2-13 and A.2-22). The longer distance is comparable to 2 of the 20 Oil-Spill-Risk Analysis land segments (LS's) that surround the proposed lease area.

Specifically, a large spill in the northern part of the proposed lease area would have a 14-18% chance of contacting Chinitna Bay, Iliamna Point, or Tuxedni Bay within 30 days (Table A.2-6, L1 or L2, LS 33, 34, and 35). The similar risk to the Kenai Peninsula would be less than 4% from a summer or winter spill (LS's 41-49).

A spill in the central part of the proposed lease area would have an 8-4% chance of contacting Augustine Island or a land segment in southern Kamishak Bay (see Table A.2-6, L4 or P3, LS's 25-32). The risk of the same spill to the east side of Cook Inlet would be less than 1% (LS's 41-49).

The risk from a spill in the southern part of Cook Inlet would extend down Shelikof Strait, mainly on the northwestern side. A spill would have a 7-9% chance of contacting the southern part of Shelikof Strait within 30 days (see Table A.2-3, L6 and L7, Environmental Resource Area [ERA] 29). Additional details about the risk to specific land segments (and, therefore, their intertidal communities) are included in Section IV.B.1.h.

In Section III.B.1, three land segments are described as sensitive because of lower trophic-level organisms: Kalgin Island (LS 38), Clam Gulch (LS 43), and Seldovia (LS 47). If a spill occurred at a hypothetical production platform in the lease area at any time during the year, the probability of contact with any of these three land segments within 30 days would be less than 4% (Table A.2-6). If a spill occurred along a hypothetical pipeline, the corresponding probability would be less than 6%. The effects of a hypothetical spill on clams are discussed further in the section on sport fishing.

As explained in the previous Cook Inlet EIS, studies of the *Exxon Valdez* oil spill show that significant hydrocarbon concentrations in intertidal sediments were found at heavily oiled sites followed by an apparent migration of the oil into the shallow subtidal zone in 1991 (Wolfe et al., 1993). Oil in the intertidal and subtidal zones can affect not only lower trophic-level organisms but also higher trophic-level organisms, such as fish (Section IV.B.1.d(5)) and birds (Section IV.B.1.g). The summary of effects of oil on intertidal and shallow benthic communities in the previous Cook Inlet EIS is repeated below and incorporated by reference:

> The sublethal effects of oil on marine plants include reduced growth and photosynthetic and reproductive activity. The sublethal effects of oil on marine invertebrates include adverse effects on reproduction, recruitment, physiology, growth, development, and behavior (feeding, mating, and habitat selection). Marine plants and invertebrates in subtidal areas are not likely to be contacted by an oil spill, except for floating larval forms, which may be contacted anywhere near the surface. Marine plants and invertebrates in intertidal and shallow subtidal areas are likely to be contacted by an oil spill. Attempts to clean oiled habitats are expected to exacerbate adverse effects and increase recovery time (USDOI, MMS, Alaska OCS Region, 1995:Section IV.B.1.b(4)(b)).

This assessment, however, does not confirm the scale of the previous assessment on shorelines, which assumed a 50,000-barrel spill that could contact shorelines in much of Cook Inlet and some of the Shelikof Strait, or that the likelihood of coastal impact was 94% (USDOI, MMS, Alaska OCS Region,1980:i). This assessment concludes that only 10-24 miles (17-38 kilometers) of shoreline, most likely on the western side of Cook Inlet, would be contacted by an assumed 1,500- or 4,600-barrel spill. Furthermore, the previous assessment assumed that in low wave-energy habitats, recovery may take up to 7 years; however, ongoing studies of the *Exxon Valdez* oil spill show that the effects can persist in Prince William Sound shoreline sediments, intertidal organisms, sea otters, and ducks for more than a decade (www.oilspill.state.ak.us/facts/lingeringoil.html). While these studies might be applicable to the east side of Cook Inlet, the west side is covered by ice for part of the year, and spilled oil might persist there for a longer time. A recent study of spilled oil on an Arctic Ocean shoreline showed that residues can persist there for 2 decades (Prince, Owens, and Sergy, 2002).

IV.B.1.c(3)(c) Large Natural Gas Release

An accidental release of natural gas from a gas-well blowout or pipeline rupture is not expected to have measurable effects on Cook Inlet lower trophic-level organisms.

IV.B.1.c(4) Summary of Effects from Sale 191

Routine activities during exploration, development, and production probably would not measurably affect local populations of lower trophic-level organisms. In the unlikely event that a large oil spill occurred, the spill and the likely response to it would affect those populations. Cook Inlet is unlike most OCS areas in that it is an estuary with surrounding shoreline. Even though large spills are unlikely, if they occur the likelihood of contact with part of the shoreline is relatively high. We estimate that a 1,500-barrel production platform or 4,600-barrel pipeline spill could contaminate 10-24 miles (17-38 kilometers) of shoreline in southwestern Cook Inlet and western Shelikof Strait. The longer distance is comparable to 2 of the 20 Oil-Spill-Risk Analysis land segments that surround the proposed sale area. The risk to the intertidal habitats on the east side of Cook Inlet is low; for example, if a spill occurred at a hypothetical production platform in the proposed sale area at any time during the year, the probability of contact with Clam Gulch (LS 43) within 30 days would be less than 4%. Local populations of intertidal organisms would be depressed measurably for about a year, and small amounts of oil could persist in shoreline sediments for a decade. These same effects as a result of Sale 199 would be delayed by about 2 years but otherwise would be similar in magnitude.

IV.B.1.c(5) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

If the scenario takes place exclusively as the result of Sale 199, the activities would be undertaken 2 years later (starting in 2006) but would not differ in location, duration, or magnitude. The actions would cause the same effects described above but would occur 2 years later.

IV.B.1.c(6) Effectiveness of Mitigation Measures

Oil-spill-response plans and dispersant-use guidelines would provide some protection to sensitive intertidal habitats. The ITL clause Information on Sensitive Areas to Be Considered in the Oil-Spill Contingency Plans also would help to protect sensitive habitats. Lessees are informed that these areas should be protected in the event of an oil spill. However, oil-spill responses likely would not prevent a large spill from contacting any coastline anywhere. Furthermore, oil-spill response could adversely affect lower-trophic level organisms; for example, dispersants could temporarily affect subtidal benthic organisms. Furthermore, in the event of a large oil spill, cleanup techniques and the presence of many humans or heavy equipment on shorelines in the area likely would kill some coastal organisms. This effect is expected to persist during cleanup operations and for less than a year afterwards.

IV.B.1.d. Effects of Sale 191 on Fisheries Resources

Fisheries resources (i.e., pelagic finfish, ground finfish, and shellfish) in the lower Cook Inlet area are described in Section III.B.2. Our analysis relies on population-level impacts; our definition of a population is defined here as a group of organisms of one species, occupying a defined area (the central Gulf of Alaska encompassing the South Alaskan Peninsula, Kodiak Archipelago, Shelikof Strait, Cook Inlet, and Prince William Sound) and usually isolated to some degree from other similar groups.

Routine activities associated with this alternative that may adversely affect fisheries resources include permitted drilling discharges, offshore and onshore construction activities, and seismic surveys. Accidental activities that may affect fisheries resources include exposure to spilled hydrocarbons. For the analysis of this sale, we assume that one large oil spill greater than or equal to 1,000 barrels and a number of smaller oil spills would occur. For the purposes of analysis, we also assume one 4,600-barrel spill would occur. This section describes the potential effects of oil to fisheries resources in the sale area using the Oil-Spill-Risk Analysis (see Appendix A) model. For example, Table A.1-5 indicates that a 4,600-barrel spill in lower Cook Inlet during summer would have a discontinuous area of approximately 56 square kilometers after 3 days, 265 square kilometers after 10 days, and 1,100 square kilometers after 30 days.

IV.B.1.d(1) Conclusion

The Oil-Spill-Risk Analysis estimates a 19% probability that one or more spills greater than or equal to 1,000 barrels could occur. The estimated effects of a large oil spill on fisheries resources would not result in a significant decline in abundance requiring three or more generations for an overall population to recover to its former status. The likely effects of a large oil spill would include the mortality of some adult forage fishes, and lethal and sublethal effects to millions of eggs and juvenile stages of finfishes and shellfishes. A large spill impacting subtidal and intertidal habitat areas would have the greatest impact to fisheries resources, chiefly resulting in lethal and sublethal effects on forage fish and intertidal species. Impacts probably would effect subpopulations lasting multiple generations. Fishes contacting spilled oil may be tainted and undesirable for human consumption. However, overall populations in the central Gulf of Alaska are not expected to experience measurable declines. Disturbance, displacement, or injury as a result of drilling or seismic activities would be slight to subpopulations of fisheries resources. We do not expect that the various effects to fisheries resources, taken altogether, would cause population-level changes in the central Gulf of Alaska.

IV.B.1.d(2) Effects from Exploration

Except for the occurrence of a large oil spill, the effects of exploration- and production-related activities on fisheries resources are expected to be essentially the same and are discussed under development and production. Although there may be minor differences in the frequency or type of activities between exploration and production, those differences would not make a measurable difference on fisheries resources.

IV.B.1.d(3) Effects from Development and Production

IV.B.1.d(3)(a) Effects from Routine Operations

IV.B.1.d(3)(a)1) Effects of Drilling Discharges on Fisheries Resources

As discussed in Section III, drilling discharges affect localized areas of the benthos, and their fluid components are diluted rapidly by marine waters (Dames and Moore, 1978). The MMS anticipates discharges of drilling muds and cuttings to occur only during exploration-drilling operations. The MMS anticipates that lessees and operators of new production platforms will be required by the Environmental Protection Agency to reinject production and development discharges of produced waters, drilling muds, and cuttings into existing wells. This expectation is based on the Environmental Protection Agency's goal of achieving a zero discharge from offshore platforms in addition to advances made as best available technology platform designs enabling them to reinject such wastes.

During exploratory-drilling operations, bulk drilling mud, usually about 100-200 barrels at a time, is discharged several times during the drilling of a well, when the composition of the drilling mud has to be changed substantially or when the volume exceeds the capacity of the mud tanks. Washed drill cuttings and a small volume of drilling mud solids are continuously discharged during drilling operations; the discharge rate varies from about 25-250 barrels per day. The most recent general NPDES permit for Cook Inlet oil and gas discharges (AKG285000; Environmental Protection Agency, 1999) allows discharge of only muds with negligible toxicity (greater than 30,000 parts per million) as measured by an LC_{50} test (see Section IV.B.1.a(2)(c)). An LC_{50} test measures the lethal concentration for 50% of the test organisms exposed during a 96-hour period. Concentrations of 1-100 parts per million are toxic to 50% of the organisms exposed over a 96-hour period.

Section 403(c) of the Federal Water Pollution Control Act (Clean Water Act) regulations allow only a 100-meter radius mixing zone for initial dilution of discharges in OCS waters. Additionally, the waters of Cook Inlet generally are vertically well mixed and strongly influenced by the tidal cycle. Juvenile and adult fishes are not likely to incur acute (lethal) toxic effects from exposure to permitted discharges within the Federal mixing zone, because (a) the concentrations are of negligible toxicity by Environmental Protection Agency standards, (b) discharge concentrations of negligible toxicity would become rapidly diluted within the mixing zone by waters of Cook Inlet as they are swept past the discharge point by strong tidal currents, and (c) the timing of drilling discharges in juxtaposition with the presence of considerable numbers of juvenile and adult fishes in the mixing zone for each exploratory or delineation well drilled. Juvenile and adult fishes occurring within the mixing zone may experience sublethal effects; however, these effects are slight and not predicted to impact fish populations. Eggs, fry, and small prey occurring in or entering the mixing zone during discharge of muds and cuttings may experience lethal and sublethal effects if they are very close (within 1-2 meters) to the discharge point, and volumes of muds and cuttings are released at rates permitted by the Environmental Protection Agency (500-1,00 barrels per hour, depending on water depth). Such lethal and sublethal effects most likely would result from physical damage or smothering resulting from the bulk constituents comprising muds and cuttings. Only very small numbers of eggs, larvae, or prey are believed susceptible to such close exposure, due to the limited periods of high discharge rates; the few exploratory wells (totaling seven wells for both lease sales) to be drilled over a 4-year period; and relative to the widespread distribution of eggs, larvae, and prey in Cook Inlet. Such minor mortality of eggs, larvae, and prey is considered negligible to the population dynamics of fisheries resources in the defined area. Sediment deposition during discharges and physical activities associated with the drilling operations likely would disturb and displace fishes from the immediate area. In some cases, discharge points may be located at or near the seafloor. If demersal fishes are present at the time of discharge, they probably would be disturbed and displaced from the immediate vicinity of the discharge, within a radius probably not to exceed 100 meters. Fishes may reinhabit the immediate drilling area within minutes to hours after drilling or discharging operations cease. Consequently, we conclude that the estimated mass/volume of discharged material probably would have a negligible effect on subpopulations of fisheries resources inhabiting the waters of the sale area. The area affected over time is too limited to have measurable adverse effects to populations of fisheries resources in the defined area.

IV.B.1.d(3)(a)2) Effects of Offshore Construction on Fisheries Resources

Construction of permanent facilities and pipelines may be required during and following offshore drilling. The Proposed Action scenario includes the construction of one platform and approximately 50 miles of offshore pipeline. Fishes inhabiting or transiting lower Cook Inlet could be subjected to offshore vessel traffic, and offshore/onshore construction activities from the Proposal. These activities may disturb pelagic and demersal finfishes and shellfishes, potentially displacing them from preferred habitat, as turbidity, vibrations, and noise from construction increases. Positive effects may accrue because following construction, offshore structures provide refugia to some species and their prey. Any disturbance or displacement should be localized and short term (hours to days to months), limited to only the time of construction and shortly thereafter. Effects chiefly would be limited to negligible numbers of individuals in the immediate vicinity of construction activities.

IV.B.1.d(3)(a)3) Effects of Onshore Pipeline Construction on Fisheries Resources

Onshore, up to 75 miles of oil pipeline may need to be constructed from the landfall north of Anchor Point to the Nikiski oil and gas complex either in existing or anticipated pipeline corridors near the Sterling Highway. While an exact route cannot be established, the pipeline route would have to comply with the following Alaska Coastal Management Plan policies, as outlined in Sections IV.B.1.s(3)(d) and IV.B.1.s(3)(e). The landfall would avoid sensitive aquatic habitat. The route for the pipeline would be sited inland from shorelines and beaches, and pipeline crossings of anadromous fish streams would be minimized and consolidated with other utility and road crossings of such streams. Pipelines would be buried wherever possible and sited in existing rights-of-way for other utilities or transportation systems wherever possible, such as that provided by the Sterling Highway. The pipelines would be designed, constructed, and maintained to minimize risk to fish habitats from a spill, pipeline break, or other construction activity.

IV.B.1.d(3)(a)4) Effects of Seismic Surveys on Fisheries Resources

Seismic surveys, probably using airguns, would be used during oil and gas exploration and development in the proposed sale area. Airguns are the type of device most frequently used in geophysical surveys in marine waters. Comparison of sounds from airguns indicates that marine fish can hear airgun sounds (Pearson, Skalski, and Malme, 1992). The frequency spectra of seismic-survey devices cover the range of frequencies detected by most fish, for example, 50-3000 Hertz for marine fish in general (Pearson, Skalski, and Malme, 1992; Platt and Popper, 1981, Hawkins, 1981). Available information indicates that marine fish are quite likely to detect airgun emissions nearly 2.7-63 kilometers (1.6-39 miles) from their source, depending on water depth (Pearson, Skalski, and Malme, 1992). In a study investigating the effects of airguns on rockfish behavior, Pearson, Skalski, and Malme, (1992) found the effects were evident as (1) shifts in the vertical distribution (either up or down), (2) shifts in behavior, and (3) the occurrence of alarm and startle responses. Responses were species specific. The threshold for startle responses was between 200 and 205 decibels re 1 microPascal; the general threshold for the alarm responses was about 180 decibels re 1 microPascal. Avoidance and other more subtle behavioral responses may occur, but limitations of the study enclosure prevented their expression.

Wardle et al. (2001) observed and tracked marine fishes on an inshore reef before, during, and after an airgun array was deployed and repeatedly fired onsite. The authors found that airgun emissions caused startle responses in all observed fishes to an observable range of 109 meters (119 yards) from the sound source and a sound pressure level of 195 decibels re 1 microPascal. One of two fish tracked at the reef during the study was found to react as airguns fired at a range of 10 meters (11 yards), whereby the fish immediately moved away from the airgun to a range of 30 meters (33 yards). The authors concluded that fishes remained close to and in the region of the airguns continuing their daily routines. However, the study's timing of airgun firings (approximately one firing per minute) did not match airgun firings used by the offshore oil and gas industry, which typically emit an acoustic-energy pulse every few seconds, creating a regular series of strong acoustic impulses separated by silent periods lasting 7-16 seconds, depending on survey type and depth to the target formations.

Hence, seismic surveys can disturb and displace fishes and interrupt feeding (Pearson, Skalski, and Malme, 1989), although information suggests that displacement may be relative to the behavioral ecology of species involved (for example, demersal versus pelagic) . For example, inshore and reef fish species that are closely associated with live bottoms (for example, reefs) are not easily displaced from their home area (Wardle et al., 2001). Recent studies suggest that some pelagic or nomadic fishes leave the survey area during seismic surveys (Engas et al., 1996, 1993; Lokkeborg and Soldal, 1993). The change in distribution can lead to observations of catch increases in some areas and reductions in others (Lokkeborg, 1991). The areas apparently affected extended up to 33 kilometers from the survey center.

McCauley et al. (2003) found that the ears of fish (pink snapper [*Pagrus auratus*]) exposed to an operating airgun (with a sound source level of 203.6 decibels re 1 microPascal) sustained extensive damage to their auditory hair cells. The airgun was towed from start up at 400-800 meters (437-874 yards) away to 5-15 meers (5-16 yards) at closest approach to the fish. The auditory damage was severe, with no evidence of repair or replacement of damaged sensory cells up to 58 days after exposure to airgun emissions. The indirect impacts of exposure on the fecundity and survival of fishes is not certain. Fishes with impaired hearing may have reduced fitness, potentially making them vulnerable to predators, possibly unable to locate prey, sense their acoustic environment or, in the case of vocal fishes, unable to communicate with other fishes. Some fishes exposed to airgun emissions have been observed to display aberrant and disoriented swimming behavior, suggesting that damage to the ears may also have vestibular impacts (McCauley et al., 2003). There is some evidence indicating that seismic-survey acoustic-energy sources damage eggs and fry of some fishes (American Petroleum Institute, 1987). This harm apparently is limited to within 1 or 2 meters from the airgun-discharge ports. Additional information concerning the potential effects that seismic surveys may cause to fish populations in Cook Inlet may be found in Section IV.B.1.e (Effects on Essential Fish Habitat).

The Proposed Action scenario forecasts that postlease site-specific seismic surveys covering a total of 161 square kilometers (62.3 square miles) would be conducted between the years of 2006-2010 (Table II.B-1). Each postlease survey covers an approximate 23-square-kilometer (9-square-mile) area. The estimated time required to survey the total area is between 14 and 35 days, although not necessarily on concurrent days. Surveys of exploration and delineation-well sites would be conducted during the late summer and early fall seasons to minimize conflicts with other users of Cook Inlet and to allow surveys to take place during the ice-free period.

Given the relative scattered distribution and hypothetical frequency of postlease seismic surveys expected to occur to cover approximately 161 square kilometers (62.3 square miles) during 14-35 days dispersed over 4 years, the effects of seismic surveys to fish populations in the proposed sale area and adjacent waters are not expected to be significant. It is possible that seismic surveys temporarily may displace fishes from the proximate area where airguns are in use. Seismic surveys are fleeting operations; hence, any fishes proximately displaced due to potential avoidance are likely to backfill the surveyed area in a matter of minutes to hours. Fishes of any life stage in close proximity to airgun emissions may suffer sublethal injuries that reduce individual fitness, fecundity, or survival. However, eggs and fry are believed to be widely distributed in Cook Inlet, and seismic surveys are expected to be limited in frequency. Consequently, large numbers of eggs or fry are not likely to be subjected to this harm. We expect that seismic surveys would have no measurable lethal effects on fish populations in the defined area. Indirect effects are considered to be closely limited in area and time and, therefore, without significance to regional fish populations.

IV.B.1.d(3)(b) Effects from Oil Spills

IV.B.1.d(3)(b)1) Effects of Oil Spills on Fisheries Resources

There are two general ways that oil spills adversely affect the abundance of a population: through direct mortality or through indirect impacts on reproduction and survival (Hilborn, 1996). In each case the impacts might be followed by recovery to pre-impact levels or by a permanent change in abundance. Permanent habitat change or a change in competitive or predation pressure could result in a long-term change in the abundance of a species.

Oil spills can more specifically affect fisheries resources in many ways, including the following:

1. cause unnatural mortality to eggs and immature stages, abnormal development, or delayed growth due to acute or chronic exposures in spawning or nursery areas;

2. impede the access of migratory fishes to spawning habitat because of contaminated waterways;
3. alter behavior;
4. displace individuals from preferred habitat;
5. constrain or eliminate prey populations normally available for consumption;
6. impair feeding, growth, or reproduction;
7. contaminate organs and tissues and cause physiological responses, including stress;
8. reduce individual fitness and survival, thereby increasing susceptibility to predation, parasitism, zoonotic diseases, or other environmental perturbations;
9. increase or introduce genetic abnormalities within gene pools, and
10. modify community structure that benefits some fisheries resources and detracts others.

Concentrations of petroleum hydrocarbons are acutely toxic to finfishes a short distance from and a short time after a spill event (Malins, 1977; Kinney, Button, and Schell, 1969). However, the majority of adult finfish are able to leave or avoid areas of heavy pollution and, thus, avoid acute intoxication and toxicity. Evidence indicates that populations of free-swimming finfish are not injured by oil spills in the open sea (Patin, 1999). Conversely, floating eggs, and juvenile stages of many species can be killed when contacted by oil (Patin, 1999), regardless of the habitat. In coastal shallow waters with slow water exchange, oil spills may kill or injure demersal finfish, shellfish, and other invertebrates in addition to cultivated species.

The contact of aquatic organisms with oil most often results in the appearance of oil odor and flavor in their tissues (Patin, 1999). In the case of commercially valued fishery resources, this certainly means the loss of their value and corresponding fisheries losses. Experimental studies show that the range of water concentrations of oil causing the taint in fish, crustaceans, and mollusks is very wide. Usually, these concentrations vary between 0.01 and 1.0 milligrams per liter, depending on the oil type; composition; form (dissolved, slick, emulsion); duration and conditions of exposure; kind of organism; and other factors (Patin, 1999). Migratory fishes (for example, salmon or herring) tainted by oil in one location may move well beyond the recognized boundaries of an oil spill, thereby become available for harvesting elsewhere. Patin (1999) drew the following conclusions of various studies devoted to the tainting of commercial organisms in oil-polluted areas:

- The contact of commercial fish and invertebrates with oil during accidental oil spills practically always leads to accumulation of oil hydrocarbons in their tissues and organs (usually within the ranges of 1-100 milligrams per kilogram). In most cases, the organisms acquire an oil odor and flavor. This fact is the main reason for closing fisheries in the affected area.
- Species reared in coastal mariculture/aquaculture facilities can be exposed to severe impacts of accidental oil spills. Observations showed that several months after the spill, salmon cultivated at facilities still had elevated concentrations of oil hydrocarbons in their tissues and suffered diseases and increased mortality (citing MLA, 1993a).

While tainting of fisheries resources in some regions may not pose a real threat to consumers (for example, the North Sea), fish tainting can be a real problem especially for coastal fishing and aquaculture (Patin, 1999).

Weathervane scallop beds located off Augustine Island in 38-115 meters (120-360 feet) of water likely would go undamaged in the event that an oil spill passes through the area. In all likelihood, their depth would serve to segregate them from direct impacts associated with a floating oil slick at the sea surface. However, these scallop beds may become commercially unacceptable for market due to actual or perceived contamination and tainting. Actual contamination is possible; however, the likelihood is regarded as low, in part due to the large water exchanges that occur as part of the dynamic hydrography of Cook Inlet.

The most serious concerns arise regarding the potential sublethal effects in fisheries resources, including commercially valued species, when exposed to chronic contamination within their habitats (Patin, 1999). It is striking that the toxicity of oil pollution to aquatic populations has been seriously underestimated by standard short-term toxicity assays, and the habitat damage that results from oil contamination has been correspondingly underestimated (Ott, Peterson, and Rice, 2001). Research studies show that intertidal or shallow benthic substrates may become sources of persistent pollution by toxic polycyclic aromatic hydrocarbons following oil spills or from chronic discharges (Rice et al., 2000). Bivalves exposed to background contamination of polycyclic aromatic hydrocarbons may experience biological responses at the cellular level, disease, and histopathological changes (Patin, 1999). Finfish sublethal responses include a wide range of compensational changes (Patin, 1999). These start at the subcellular level and first have a biochemical and molecular nature. Recent research, mostly motivated by the *Exxon Valdez* oil spill, has found (1) polycyclic aromatic hydrocarbons are released from oil films and droplets at progressively slower rates with increasing molecular weight leading to greater persistence of larger polycyclic aromatic hydrocarbons; (2) eggs from demersally-spawning fish species accumulate dissolved polycyclic aromatic hydrocarbons released from oiled substrates, even when the oil is heavily weathered; and (3) polycyclic aromatic hydrocarbons accumulated from aqueous concentrations of less than 1 part per billion can lead to adverse sequelae appearing at random over an exposed individual's lifespan (Rice et al., 2000). These adverse effects likely result from genetic damage acquired during early embryogenesis caused by superoxide production in response to polycyclic aromatic hydrocarbons. Therefore, oil poisoning is slow acting following embryonic exposure, and adverse consequences may not manifest until much later in life. The frequency of any one symptom usually is low, but cumulative effects of all symptoms may be considerably higher (Rice et al., 2000). For example, if chronic exposures persist, stress may manifest sublethal effects later in a form of histological, physiological, behavioral, and even populational responses, including impairment of feeding, growth, and reproduction (Patin, 1999). Chronic stress and poisoning also may reduce fecundity and survival through increased susceptibility to predation, parasite infestation, and zoonotic diseases. These can affect the population abundance and subsequently community structure. For more information summarizing the various adverse effects (both individual and population level) to ichthyofauna or their habitats, please see Tables 29 and 30 of Patin (1999).

IV.B.1d(3)(b)2) Pelagic Finfishes

Potential oil-spill impacts to pelagic finfishes in the Gulf of Alaska are best known for salmon and Pacific herring. Salmon are able to detect and avoid hydrocarbons in the water (Weber, 1988), although some salmon may not avoid oiled areas and become temporarily disoriented but eventually returning to their home stream (Martin, 1992). Adult salmon remain relatively unaffected by oil spills and are able to return to natal streams and hatcheries even under very large oil-spill conditions, as evidenced by pink and red salmon returning to Prince William Sound and red salmon returning to Cook Inlet after the *Exxon Valdez* oil spill in 1989. When oil from the *Exxon Valdez* spill entered Cook Inlet, the Alaska Department of Fish and Game closed the sockeye salmon commercial fishery in Cook Inlet. This evidently resulted in overescapement of spawning fish in the Kenai River system for the third consecutive year. Overescapement in 1987 was due to a previous spill, and in 1988 there was a naturally high escapement. As a result of the repeated overescapements, fisheries managers observed what appeared to be a decline in salmon smolt. Although the mechanism for the apparent decline in smolt abundance is uncertain, the result of overescapement and too many salmon fry to be supported by the available prey may be the cause. The extent of the decline was speculative. Managers originally predicted that adult salmon returns in 1994 and 1995 would be below escapement goals, but the 1994 returns were three times that forecasted. Figures for 1995 are not available at this time, but escapement goals were met, and commercial fisheries were operating. Many finfish species are most susceptible to stress and toxic substances during the egg and larval stages than adult stage. Intertidal areas contaminated by spilled oil may persist for years and represent a persistent source of harmful contaminants to aquatic organisms. Contamination of intertidal spawning stream areas for pink salmon caused increased embryo mortality and possible long-term developmental and genetic damage (Bue et al., 1998). The embryo, a critical stage of salmon development, is vulnerable because of its long incubation in intertidal gravel and its large lipid-rich yolk, which will accumulate hydrocarbons from chronic, low-level exposures (Moles et al., 1997; Marty et al., 1997; Heintz, Short, and Rice, 1999). Pink salmon (often intertidal spawners) embryos in oiled intertidal stream areas of Prince William Sound continued to show higher mortality than those in nonoiled stream areas through 1993, more than 4 years after the oil spill, but appeared to recover in 1994 (Bue et al., 1998). Experiments conducted by Heintz, Short, and Rice (1999) demonstrate that aqueous-total polycyclic aromatic hydrocarbons concentrations as low as 1 part per billion derived from weathered *Exxon Valdez* oil can kill pink salmon embryos localized downstream from oil sources. Their study also found a 25% reduction in survival during incubation of brood fish exposed to 18 parts per billion. Other studies examining egg and fry survival showed no difference between oiled and unoiled locations (Brannon et al., 1993) except in two cases—one that showed higher mortality at an unoiled stream and another that showed higher mortality at the high-tide station of an oiled stream. These studies did not measure polycyclic aromatic hydrocarbons in stream water or in salmon embryos, were statistically underpowered, and were insufficient in duration to test for the manifestation of adverse effects from low-level polycyclic aromatic hydrocarbon exposures (Murphy et al., 1999). Results published by Murphy et al. (1999) and Heintz, Short, and Rice (1999) contradict other scientists' conclusions that polycyclic aromatic hydrocarbon concentration in spawning substrate after the spill was too low to adversely affect developing salmon (i.e., Brannon et al., 1995; Maki et al., 1995; Brannon and Maki, 1996).

Several studies demonstrated indirect and chronically adverse effects of oil to intertidal fish at levels below the water-quality guidelines of 15 parts per billion. Experiments conducted by Heintz, Short, and Rice, (1999) demonstrate that between the end of chronic exposure to embryonic salmon and their maturity, survival was reduced further by another 15%, resulting in the production of 40% fewer mature adults than the unexposed population. Heintz, Short, and Rice (1999) concluded the true effect of the exposure on the population was 50% greater than was concluded after evaluating the direct effects. Additional research found that fewer exposed fish from one experimentally exposed egg brood survived life at sea and returned as mature adults compared to unexposed fish (Heintz, 2000). Moreover, Heintz et al. (2000) experimental data show a dependence of early marine growth on exposure level; unexposed salmon increased their mass significantly more than salmon exposed to crude oil as embryos in eggs. Heintz et al. (2000) concluded that exposure of embryonic pink salmon to polycyclic aromatic hydrocarbon concentrations in the low parts per billion produced sublethal effects that led to reduced growth and survival at sea. Studies, therefore, indicate that examination of short-term consequences underestimate the impacts of oil pollution (Heintz et al., 2000; Rice et al., 2000; Ott, Peterson, and Rice, 2001). When oil contaminates natal habitats, the immediate effects in one generation may combine with delayed effects in another to increase the overall impact on the population. If oil spills enter small areas of intertidal habitats, small scale impacts to affected egg and larval habitats could last for one or more generations of a subpopulation.

It is important to note here that hypothesis testing using statistical "significance" as tested in many studies emanating from the *Exxon Valdez* oil spill are not necessarily appropriate for assessing oil-spill impacts. Instead, Hilborn (1996) recommended examining likelihoods or using Bayesian statistics to measure likely oil-spill impacts to avoid the common confusion between statistical and biological significance. Some Pacific herring stocks of the Gulf of Alaska were appreciably impacted by past oil spills. The *Exxon Valdez* oil spill occurred a few weeks before Pacific herring spawned in Prince William Sound. A considerable portion of spawning habitat, and staging areas in Prince William Sound, were contaminated by oil. Adult herring returning to spawn in Prince William Sound in 1989 were relatively unaffected by the spill and successfully left one of the largest egg depositions since the early 1970's. Total herring-spawn length for 1989 was 158 kilometers, with 96% in unoiled areas, 3% in areas of light to very light oiling, and only 1% in areas characterized as moderate to heavy oiling (Pearson, Mokness, and Skalski, 1993). About half of the egg biomass was deposited within the oil trajectory and an estimated 40-50% sustained oil exposure during early development (Brown et al. 1996). Other researchers estimated that more than 40% of the areas used by the Prince William Sound stocks for spawning and more than 90% of the nearshore nursery areas were exposed to spilled crude oil (Biggs and Baker, 1993).

McGurk and Brown (1996) tested the instantaneous daily rates of egg-larval mortality of Pacific herring at oiled and nonoiled sites; they found that the mean egg-larval mortality in the oiled areas was twice as great as in the nonoiled areas, and larval growth rates were about half those measure in populations from other areas of the North Pacific Ocean. Norcross et al. (1996) collected Pacific herring larvae throughout Prince William Sound in 1989 following the *Exxon Valdez* oil spill. They found deformed larvae both inside and outside of areas considered as oiled. Many larvae exhibited symptoms associated with oil exposure in laboratory experiments and other oil spills. These included morphological malformations, genetic damage, and small size. Growth was stunted during developmental periods. Brown et al. (1996) noted the resulting 1989 year-class displayed sublethal effects in newly hatched larvae, primarily premature hatch, low weights, reduced growth, and increased morphologic and genetic abnormalities. In newly hatched larvae, developmental aberration rates were elevated at oiled sites, and in pelagic larvae genetic damage was greatest near oiled areas of southwestern Prince William Sound. Brown et al. (1996) estimated that oiled areas produced only 0.016×10^9 pelagic larvae compared with 11.82×10^9 non-oiled areas. Kocan et al. (1996) exposed Pacific herring embryos to oil-water dispersions of Prudhoe Bay crude oil in artificial seawater and found that genetic damage was the most sensitive biomarker for oil exposure, followed by physical deformities, reduced mitotic activity, lower hatch weight, and premature hatching.

Herring populations are dominated by occasional, very strong year classes that are recruited into the overall population (http://www.oilspill.state.ak.us/facts/status_herring.html). The 1988 prespill year-class of Pacific herring was very strong in Prince William Sound and, as a result, the estimated peak biomass of spawning adults in 1992 was very high. Despite the large spawning biomass in 1992, the population exhibited a density-dependent reduction in size of individuals, and in 1993 there was an unprecedented crash of the adult herring population. The 1989-year class was a minority of the 1993 spawning assemblage, one of the smallest cohorts observed in Prince William Sound, and it returned to spawn with an adult herring population reduced by approximately 75%, apparently because of a widespread epizootic. A viral disease and fungus may have been the immediate agents of mortality or a consequence of other stresses, such as a reduced food supply and increased competition for food. There have been no “very strong” year classes recruited into the Prince William Sound herring population since 1988. The Pacific herring stock of Prince William Sound is classified as “not recovered” from the *Exxon Valdez* oil spill of 1989.

IV.B.1.d(3)(b)3) Demersal and Bentho-Pelagic Finfishes

Pollock, sablefish, Pacific cod, eulachon, and Pacific sand lance are representative species in the Cook Inlet area collectively known as bentho-pelagic finfishes. Such finfishes may inhabit the benthos or pelagic waters at times. Vertical changes in depth may be responses to factors such as light conditions and foraging opportunities. For example, Pacific sand lance inhabit the water column nearshore during the day, but bury themselves at night in soft bottom sediments. They also are known to overwinter by burying in sediments, with a preference for fine or coarse sand substrate. This makes them particularly vulnerable to oil spills impacting nearshore areas. The principal demersal finfishes in the Cook Inlet area are Pacific halibut, a number of other flatfishes, and rockfishes. They inhabit benthic areas over most of the proposed Sale 191 area.

Demersal and bentho-pelagic finfishes inhabiting oil polluted areas may suffer similar lethal and sublethal effects (for example, egg mortality, developmental aberrations, reduced survival, etc.) as reported for pelagic finfishes, although not necessarily of the same magnitude as finfish assemblages using nearshore and intertidal habitats.

Pollock sampled from Prince William Sound and Tugidak Island in 1990 following the *Exxon Valdez* oil spill showed evidence of fluorescent aromatic compounds, but these dropped substantially in 1991 (Collier et al., 1996). Overall, Collier et al. (1996) results show a continuing exposure of several subtidal fish species.

Moles and Norcross (1998) found that juvenile yellowfin sole, rock sole, and Pacific halibut experienced reduced growth following 30-90 days of exposure to sediments laden with Alaska North Slope crude oil. Changes in fish health bioindicatiors after 90 days—i.e,. increases in fin erosion, liver lipidosis, gill hyperplasia, and gill parasites—coupled with decreases in macrophage aggregates, occurred at hydrocarbon concentrations (1,600 micrograms per gram) that reduced growth 34-56% among the demersal finfishes. Moles and Norcross (1998) concluded that (1) chronic hydrocarbon pollution of nearshore nursery sediments could alter growth and health of juvenile flatfishes, and (2) recruitment of juveniles to the fishery may decline because of increased susceptibility to predation and slower growth.

Rockfish (yelloweye, quillback, and copper) examined for histopathological lesions and elevated levels of hydrocarbons in their bile after the *Exxon Valdez* oil spill indicated significant differences between oiled and control locations (Hoffman, Hepler, and Hansen, 1993). Additionally, at least five rockfish examined were killed by exposure to oil. While the authors noted no population-level effect in these species, these data indicate spilled oil reached and exposed demersal fishes to both sublethal and lethal toxic effects.

Some demersal or bentho-pelagic species are sensitive to oiled substrates, and may be displaced from preferred habitat that is oiled as a result of a spill. Pinto et al., (1984) found that sand lance avoided sand contaminated with Prudhoe Bay crude oil in an experimental setting. Moles et al. (1994) exposed three species of juvenile Alaskan demersal finfishes (rock sole, yellowfin sole, and Pacific halibut) to laboratory chambers containing contaminated mud or sand offered in combination with clean mud, sand, or granule. The finfishes were able to detect and avoid heavily oiled (2%) sediment but did not avoid lower concentrations of oiled sediment (0.05%). Oiled sediment was favored over unoiled sediment, if the unoiled sediment was of the grain size not preferred by that species. Oiled sand or mud was always preferred over unoiled granule. The authors concluded that the observed lack of avoidance at concentrations likely to occur in the environment may lead to long-term exposure to contaminated sediment following a spill.

Hydrocarbon exposure in demersal fishes often results in an increase in gill parasites (Khan and Thulin, 1991; MacKenzie et al. 1995). Moles and Wade (2001) experimentally tested adult Pacific sand lance's susceptibility to parasites when exposed to oil-contaminated sediments for 3 months. They found that sand lance exposed to highly oiled substrates had the greatest mean abundance of parasites per fish. Chronic exposure to harmful pollutants such as hydrocarbons coupled with increased parasitism degrades individual fitness and survival.

IV.B.1.d(3)(b)4) Shellfish

Oil spills within the Cook Inlet region have the potential to adversely impact shellfishes. Sessile shellfish in nearshore waters, such as the bivalves, are susceptible to smothering by heavy oiling in addition to protracted exposures from spills. Thomas et al. (1999a) sampled mussels in 1996 from beaches in Prince William Sound that contained residual oil resulting from the *Exxon Valdez* oil spill. They found polycyclic aromatic hydrocarbons concentrations in mussel tissue that were significantly greater in tissue of mussels from oiled beds (0.6-2.0 micrograms per gram) than from un-oiled reference sites. Thomas et al. (1999b) found that mussels sampled at oiled beaches in Prince William Sound in 1992 and 1993 exhibited a lack of physiological response, even though they were chronically exposed to polycyclic aromatic hydrocarbons for 3-4 years. They suggested the lack of response indicates that chronically exposed mussels may develop a physiological tolerance to polycyclic aromatic hydrocarbons. Carls et al. (2001) monitored the persistence and weathering of *Exxon Valdez* oil in intertidal mussel beds in Prince William Sound and along the Gulf of Alaska from 1992-1995. They found that hydrocarbon concentrations declined significantly with time in some, but not all mussels and sediments, and should reach background levels within three decades of the spill in most beds.

Motile shellfish such as shrimp and crabs are susceptible to acute and chronic impacts from spilled oil resulting in lethal and sublethal effects as similarly described for finfishes. Also, just as some finfishes, some shellfish may be displaced by oil spills from preferred habitat. Moles and Stone (2002) tested what sediment types juvenile tanner and red king crabs selected and how oil pollution might alter their sediment preferences. In oil experiments using three sediment types (mud, sand, cobble), grain size often was more important in sediment selection than the presence or absence of contaminants. If the preferred sediment type was oiled and the alternative sediment was unoiled but of smaller grain size, both species selected the preferred sediment. Red king crabs avoided sediments containing 500-800 micrograms per gram total hydrocarbons, if unoiled sediment of the same or larger grain size was available. In contrast, tanner crabs selected fine-grained sediments whether or not oil was present. The lack of avoidance by crabs at concentrations less than 500 micrograms per gram may lead to long-term exposure to contaminated sediment in areas where benthic sediments are chronically polluted (Moles and Stone, 2002).

IV.B.1.d(3)(b)5) Oil Spill Impact Analysis

For purposes of analysis, we assume that one large oil spill greater than or equal to 1,000 barrels and a number of smaller oil spills would occur. We also assume one 4,600-barrel spill would occur. This section describes the potential effects of oil to fisheries resources in the sale area using the Oil-Spill-Risk Analysis (see Appendix A) model. For example, Table A.1-5 indicates that a 4,600-barrel spill in lower Cook Inlet would have a discontinuous area of approximately 56 square kilometers after 3 days, 265 square kilometers after 10 days, and 1,100 square kilometers after 30 days.

In the event of accidental spills, adult pelagic finfishes are believed to avoid oil slicks and slicketts. A large spill impacting only 1,100 square kilometers after 30 days may adversely impact hundreds of millions of eggs and juvenile stages of pelagic species (for example, the average female Pacific herring produces 20,000 eggs annually), including those of anadromous fishes that spawn upstream in tributaries of Cook Inlet (for example, a single female sockeye salmon produces from 2,000-4,500 eggs). These immature fishes may suffer mortality and sublethal effects that reduce individual fitness, fecundity, and survival. A large oil spill during the summer or autumn seasons may result in the greatest impact to pelagic finfishes, because this is when many pelagic migratory finfishes are most abundant and have eggs and juvenile stages present in the Cook Inlet region. Spilled oil impacting nearshore and intertidal areas would result in the greatest impacts to fisheries resources of the central Gulf of Alaska. A large oil spill and/or multiple smaller spills may cause local pelagic finfish stocks or subpopulations (of different species) to decline in abundance, requiring multiple generations for the impacted stock or subpopulation to recover to its former status. Some stocks are already in decline due to non-OCS Industry anthropogenic and natural impact-producing factors (for example, commercial fisheries, climatic regime shifts). However and importantly, because pelagic species of finfishes are relatively abundant, wide-ranging and prone to segregating by age groups in different geographic areas, but are distributed in waters across much of the central Gulf of Alaska, a large oil spill is not likely to cause a significant impact to a fisheries resource population inhabiting the central Gulf of Alaska (i.e., South Alaskan Peninsula, Kodiak Archipelago, Shelikof Strait, Cook Inlet, and Prince William Sound regions).

Section IV.B.1.a(4)(b) assumes spilled oil will disperse in seawater after 3, 10, and 30 days to a depth of 5, 10, and 30 meters, respectively. However, some oil (up to 10-30%) is adsorbed on suspended material and deposited to the seafloor (Patin, 1999). This mainly occurs in narrow coastal and shallow waters where particulates are abundant and water is subjected to intense mixing (waters of Cook Inlet are considered well mixed). In deeper areas remote from the shore, sedimentation of oil (except in heavy fractions) is an extremely slow process. Simultaneously, the process of biosedimentation occurs; plankton filtrators and other organisms absorb the emulsified oil (Patin, 1999). Their metabolites and remainders settle to the seafloor. Suspended forms of oil and its components undergo intense chemical and biological decomposition in the water column. However, this situation radically changes when the suspended oil reaches the sea bottom. The oxidation processes slow down, especially under anaerobic conditions in benthic areas. Heavy oil fractions accumulated inside sediments can be preserved for many months and even years. Twenty years after an accidental oil spill near the Atlantic coast of the U.S., bottom sediments still had a considerable amount of oil residues (Patin, 1999, citing Teal, 1993). Additionally, oil aggregates in the form of petroleum lumps and tarballs that can be found both in oceanic, coastal, and estuarine waters, as well as on beaches (Patin, 1999). About 5-10% of spilled crude oil forms these aggregates; the remainder comes from other sources. Oil aggregates can exist from a month to a year in enclosed seas and up to several years in the ocean (Patin, 1999, citing Benzhitski, 1980). They conclude their cycle by slowly degrading in the water column, on shore, or on the seafloor.

Numerous bentho-pelagic and demersal finfishes and shellfishes may be exposed to and killed or harmed by oil spills during the lifetime of the proposed action, whether by frequent small spills or one or more large spills. Species that use intertidal and nearshore habitats during their life history are most vulnerable to acute and chronic impacts that may result in lethal and sublethal effects to stocks and subpopulations within affected areas. Some bentho-pelagic and demersal finfishes and shellfishes produce large amounts of pelagic eggs and larvae that may die or incur sublethal effects if exposed in pelagic habitats. Because little is known regarding the fecundity of many bentho-pelagic and demersal finfishes, it is difficult to accurately assess the magnitude of egg and larval mortality and sublethal effects as a result of a large oil spill oiling 1,100 square kilometers after 30 days, although millions is a realistic likelihood (for example, a single female Pacific sand lance produces 1,468-16,081 eggs per year). Developing eggs and juvenile stages may suffer sublethal effects degrading individual fitness, fecundity, and survival. Species only using waters deeper than 50 meters or more are regarded as primarily at risk in the event of a pipeline spill at depth, the effects of which are poorly studied. In each oil-spill case, the magnitude of lethal and sublethal effects greatly depends on seasonal timing and environmental factors influencing the concentration and distribution of oil in the waters of Cook Inlet and beyond. Pacific sand lance spawn in late September and October; depositing eggs in intertidal waters just below the waterline. A large spill occurring in autumn and impacting spawning sites or nursery areas may result in the greatest impact to Pacific sand lance. It is important to note that oil-spill impacts to stocks or subpopulations of walleye pollock or Pacific sand lance may have serious consequences to higher vertebrate predators, because these finfishes are among the most important forage fishes in the central Gulf of Alaska and are consumed by many endangered and threatened species of sea birds and marine mammals. Although frequent small spills or one or more large spills in Cook Inlet may cause local stocks or subpopulations of shellfish, bentho-pelagic, or demersal finfish to decline in abundance requiring multiple generations to recover to its former status, they are not likely to result in a significant impact to an overall population inhabiting the central Gulf of Alaska.

IV.B.1.d(3)(b)6) Effects of Oil Spill Response Measures on Fisheries Resources

Dispersants used to mitigate oil slicks can adversely impact finfish, shellfish, and their prey. The Alaska Regional Response Team has prepared a Unified Plan that provides general guidelines, and the Subarea Plan designates where application of dispersants is appropriate. Both plans can be found online at http://www.akrrt.org/plans.shtml. The basic rule of thumb is no application of dispersants in areas shoreward of the 9-meter (5-fathom) isobath and, in some areas, that is increased to the 18-meter (10-fathom) isobath. The Subarea Plan identifies these areas. There also is an ongoing geographic response strategy program to map the entire Alaska coastline, identify sensitive habitats and species of animals at risk, and identify which response tactics should be considered first to limit oil impacts. Such information will be instrumental in minimizing the impacts of an oil spill and response activities to fisheries resources and their habitats.

IV.B.1.d(3)(b)7) Combined Probability Analysis

The combined probabilities estimate the probability of a spill occurring from all sources (transportation or platform) and contacting environmental resource areas, land segments, and sea segments during the life of the Proposal at intervals of 3, 10, and 30 days. The names and locations of environmental resource areas and land and sea segments referred to throughout this section are listed in Tables A.2-31 and 32.

The relatively low probability of oil occurrence and contact to various environmental resources is illustrated by examination of the highest probabilities. After 3 days, the combined probabilities (expressed as percent chance) for one or more oil spills of greater than or equal to 1,000 barrels occurring and contacting Tuxedni Bay (ERA 1) is 5%; for outer Kamishak Bay (ERA 4) it is 3% (Table A.2-31). After 10 days, the combined probability increases to 5% for outer Kamishak Bay (ERA 4) and to 6% for Tuxedni Bay (ERA 1). After 30 days, the combined probability of one or more oil spills greater than or equal to 1,000 barrels occurring and contacting outer Kamishak Bay or Tuxedni Bay does not change. Fish species from these resource areas potentially affected by oil spills are adult anadromous fishes and eulachon transiting lower Cook Inlet; outmigrating juvenile salmon entering Cook Inlet from natal rivers and streams; herring, true cod, and halibut; and walleye pollock in the vicinity of Cape Douglas. Additionally, pelagic eggs and juvenile stages inhabiting near-surface waters may experience lethal and sublethal effects. For all other environmental resource areas and land segments, estimated combined probabilities (expressed as a percent chance) of one or more spills greater than or equal to 1,000 barrels occurring and contacting are less than 5%.

IV.B.1.d(4) Large Natural Gas Release

If a natural gas release occurred, mortality could result to finfish or shellfish of varying life stages near the release point. Natural gas condensates in the water column may impact eggs or larvae with lethal and sublethal effects if exposed to high or moderate concentrations. A plume of natural gas vapors and condensates would disperse rapidly and is expected to produce negligible adverse impacts, affecting at most a few individuals.

IV.B.1.d(5) Summary of the Effects from Sale 191

Fishes could be disturbed and displaced from the immediate vicinity of drilling discharges, within a radius probably not to exceed 100 meters. Displacement of demersal fishes very likely would be limited to only the short time periods of the discharge. Offshore construction also could temporarily disturb and/or displace fishes proximate to the construction activity. Any disturbance or displacement is expected to be short term (hours to days) and limited to only the time of construction activity and shortly thereafter. Although seismic surveys may kill or injure eggs and fry of some fishes, this injury is limited to within 1 or 2 meters from the airgun-discharge ports. Thus, seismic surveys probably would have no appreciable adverse effects on fish subpopulations.

We reviewed the effects of an oil spill for fisheries resources in the proposed sale area. We estimated sale-specific oil-spill effects on fisheries resources using probabilities generated from the Oil-Spill-Risk Analysis model. We used effects on fisheries derived from the *Exxon Valdez* oil spill studies to estimate potentially lethal and sublethal effects of an oil spill on fisheries resources. Sale-specific oil-spill effects would likely not directly affect returning adult salmon, Dolly Varden, or steelhead trout. Oiled intertidal areas could lead to considerable mortality of eggs and juvenile stages in the affected areas. Studies show that impacted eggs and juvenile stages lead to reduced adult survival. Elevated levels of developmental malformations and physiological aberrations in eggs and juvenile stages can cause reduced survival to adulthood, thereby delaying recovery of subpopulations affected by an oil spill. Eggs and fry of some bentho-pelagic and demersal fishes may suffer lethal and sublethal effects from oil contact. Although multiple small spills or a single large spill may cause declines of a subpopulation of multiple species inhabiting the sale area, they are not expected to cause a measurable decline in abundance requiring three or more generations for the indicated population of the central Gulf of Alaska to recover to its former status.

IV.B.1.d(6) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

If the scenario takes place exclusively as the result of Sale 199, the activities would be undertaken 2 years later (starting in 2006) but would not differ in location, duration, or magnitude. The actions would cause the same effects described for Sale 191, only 2 years later.

IV.B.1.d(7) Effectiveness of Mitigating Measures

The most effective mitigating measures for fisheries resource is the stipulation on the Protection of Fisheries. With this mitigating measure in place, the effects discussed above on fisheries resource due to Alternative I likely would be minimized. To the degree that this mitigation measure is implemented, fisheries resource likely would benefit; however, its absence is not expected to substantially increase adverse effects.

IV.B.1.e. Effects of Sale 191 on Essential Fish Habitat

The Sustainable Fisheries Act (also known as the Magnuson-Stevens Reauthorization Act) requires that the North Pacific Fishery Management Council identify essential fish habitat (EFH) of managed fish species and analyze the effects of commercial fishing on such habitats. Additionally, they are required to identify potentially adverse impacts to habitat from other activities, such as Petroleum production. The Act requires Federal Agencies such as the MMS to analyze the adverse effects of their actions on the habitats the North Pacific Fishery Management Council identifies. Table III.B-1 lists the managed fish and prey species of concern. The area covered by this analyze includes all of the proposed lease sale area and adjacent waters. Maps 3 through 10 and 21 include information about areas used by the different fish species for which EFH has been described and delineated by the North Pacific Fishery Management Council (1998, 1999).

Table IV.B-5 contains the list of potential impacts identified by the North Pacific Fishery Management Council for petroleum production. Not all potential threats listed are relevant to the lease sales. This section addresses habitat alteration, topographic alteration, and portions of organism alteration. Water quality alteration and atmospheric depositions are addressed in the water quality (IV.B.1.a) and air quality (IV.B.1.b) sections of this EIS. Oceanographic alterations, gene pool deterioration, introduction of exotic species, introduction of pathogens/disease, and change in photosynthetic regime are not anticipated effects of this lease sale and will not be addressed further in this analysis.

This section is organized to satisfy requirements for NEPA and the Sustainable Fisheries Act.

- First, exploration-phase effects of seismic testing and discharge of drilling muds on the physical habitat of managed fish species are analyzed.
- Second, development- and production-phase effects on the physical habitat are analyzed. In this section, the effects from routine activities including noise and pipeline construction are analyzed. Then the potential effects of oil spills are broken down separately into effects on beach, intertidal, estuarine, and marine waters.
- Third, effects on the prey of managed fish and ecosystem-level effects are evaluated, as required in the Sustainable Fisheries Act.
- Fourth, Habitats of Particular Concern are evaluated, as required in the Sustainable Fisheries Act.

In EFH sections of this EIS, the NEPA term "impact" means the same thing as and is interchangeable with the Sustainable Fisheries Act term "adverse effect." An adverse effect (as defined in 50 CFR 600.810) means any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of or injury to benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitatwide impacts, including individual, cumulative, or synergistic consequences of actions.

For the convenience of the reader, the general conclusions are summarized here at the beginning and before the extended discussion and evaluation.

IV.B.1.e(1) Conclusion

Adverse effects on essential fish habitat from seismic surveys and construction activities (both offshore and onshore) will likely occur although the magnitude of impacts are considered very low. In most cases, impacts would be localized and habitats would recover within months to years.
The oil-spill-risk analysis projects that there is a 19% likelihood that one or more large oil spills may occur as a result of the proposed sale. In the event that a large oil spill (1,500 or 4,600 barrels) occurs, the beach and intertidal fish habitats could be most adversely affected relative to other essential fish habitats, because oil could persist in these areas or prey could be impacted for more than a decade, which is three or more generations for some species. However, such habitat degradation likely would be limited relative to the proportion of habitat available, and the habitat of only subpopulations would be affected. Impacts are likely to be on the scale of those identified after the similarly sized Glacier Bay oil spill near Nikiski; no visual effects were seen a year after the spill. Oil-spill effects on estuarine and marine essential fish habitats would generally be low because limited fish habitat would be impacted. Subtidal habitats are expected to recover over months and years. An oil spill from the assumed location in LA2 would have the greatest adverse effect. See also Tables IV.B-10, IV.B-11, and IV.B-12.

Effects at the ecosystem level are more difficult to determine. The generally low routine impacts of the proposed sale on essential fish habitats are not expected to affect the larger ecosystem at a level that could be measured. Multiple small and frequent spills and one or more possible unlikely large oil spills may displace or cause measurable declines of fisheries resource populations and prey from essential habitat area. Recovery of impacted subpopulations and habitats could require multiple generations to recover. An example would be the possible damaging effects to forage fishes, radiating throughout the food chain and magnifying adverse impacts, if an accidental large spill occurred in times of great stress or at times of extremes in the natural variation of the ecosystem. For example, pollock comprises 80% of the forage fish consumed in the ecosystem and is the primary commercially caught fish. In the event that a large spill impacts pollock or its habitat in the region, the impacts could be much greater than expected for either essential fish habitat or to predators in the ecosystem. Several endangered bird and marine mammal species feed in this ecosystem where pollock is the major food source, indicating that portions of the ecosystem already may be stressed from other human activities.

IV.B.1.e(2) Effects of Exploration

IV.B.1.e(2)(a) Effects from Disturbances, Discharges, and Noise

IV.B.1.e(2)(a)1) Seismic Surveys

We expect site-specific surveys to cover an approximate area of 23 square kilometers (9 square miles), for each exploration site. The total area covered by shallow-hazard surveys would equal 46 square kilometers (18 square miles). Annual exploratory seismic testing likely would affect 23-52 square kilometers (9-20 square miles) of habitat for 2-10 days in late summer or early fall of each year from 2005 through 2010. Fishes and their prey inhabiting Cook Inlet could be adversely affected by seismic survey activities. EFH species/complexes inhabiting Cook Inlet that may be exposed to seismic surveys include Pacific Ocean perch; northern rockfish; yellow fin sole; sculpin; walleye Pollock; rock sole; Greenland turbot; Pacific cod; flathead sole; arrowtooth flounder; rex sole; sharks, skates; all five species of Pacific salmon; various forage fish species; weathervane scallop; squid; and octopus. Pacific halibut and Pacific herring are not specifically EFH species, however, they are important species of the Cook Inlet ecosystem, particularly herring which are an important prey species to other fishes, seabirds, and marine mammals. Table III.B-1 lists the EFH species of the Gulf of Alaska region, and many of these species utilize Cook Inlet as essential habitat; the list includes brief notes on their general habitat distributions. An important habitat area within Cook Inlet is Kamishak Bay (Map 5). Forage fishes, such as Pacific herring and Pacific sand lance use Kamishak Bay as an important spawning and nursery area. Kamishak Bay is adjacent to the lease sale area. Therefore, the spawning and nursery area is not expected to be surveyed. Seismic energy does ensonify areas beyond that immediately below the sound source; hence, fishes in Kamishak Bay may be exposed to seismic energies, although such energies are understood to degrade with distance and time from the source. Consequently, seismic impacts to herring and other fishes in Kamishak Bay or other areas adjacent to OCS lands where seismic surveys are conducted are not believed to be measurably important to their respective populations. Fishes and their prey inhabiting waters directly exposed to seismic surveys may experience adverse impacts as described in the following. Demersal and bentho-pelagic finfish species using these areas may be the most likely species impacted by the noise (decibel) level.

The physical characteristics of seismic waves that can potentially degrade essential fish habitat are (1) the decibel noise volume or how loud a sound is and (2) the frequency of the sound waves. Much like earthquakes, sound volume is measured on a logarithmic scale so that 2 decibels are 10 times louder than 1 decibel (Jasny and Reynolds, 1999). Noise volume or loudness is measured in the air in decibels and in water as decibels in micropascals (decibels re 1 micropascal) (Jasny and Reynolds, 1999) or mean peak levels (decibels re ımicropascal-m). Mean-peak level (decibels re ımicropascal-m) is defined as the decibel value of the mean of sum of maximum positive and absolute value of minimum negative pressure values). The second physical characteristic of sound that can potentially degrade essential fish habitat is frequency, or how high or low the sound is in musical terms. As in radio frequencies, the frequency of seismic testing sound waves is measured in Hertz cycles.

Jasny and Reynolds (1999) related the ways in which noise from shipping, seismic, and military activities on marine animals to the way sound can affect human and terrestrial animal hearing and is summarized here. Sound can harm the ear, bringing on permanent deafness or worse—the oval window protecting the inner ear may rupture, causing a fatal loss of cerebrospinal fluid. Farther from the sound blast, the animal may experience other debilitating effects, disruptions in its equilibrium and hearing. Prolonged human exposure to continuous noise (such as from a busy factory floor) can bring about hearing loss, ringing of the ears, or obliviousness. This effect, where people have to raise their voices to be heard, is called threshold shift. Threshold shift can be permanent or temporary. Temporary shifts will turn permanent if repeated often enough. Humans begin to suffer temporary hearing loss after a few minutes of mowing the lawn, roughly 90 decibels air standard. Dolphins experience threshold shift with 1-second tones over 190 decibels. Noise starting below 140 decibels and lasting 20 minutes or more can result in lost hearing in sea lions.

As a temporary measure (until the National Marine Fisheries Service completes its underwater acoustic criteria for marine mammals), the National Marine Fisheries Service resorted to human standards, meant for the workplace, in assessing 'incidental take' applications under the Marine Mammal Protection Act. At 70 decibels above an animal's acoustic threshold (the level at which it can hear), ocean noise was presumed to affect behavior. At 80-100 decibels over an animal's threshold, noise was presumed to induce temporary hearing loss and, at 155 decibels, to cause immediate, permanent auditory damage (Jasny and Reynolds, 1999; National Research Council, 1994). However, Jasny and Reynolds (1999) indicate that behavioral changes may hinder an animal's survival without actually damaging its hearing.

In work related specifically to seismic exploration, Richardson and Malme (1993) indicate that the maximum decibel level is 242-252 decibels re 1 micropascal-m, and that an array of seismic airgun pulses emits considerable energy from below 20-250 Hertz with the strongest around 50-100 Hertz. An Alaskan example is a 1998 request for an incidental Harassment Authorization for seismic exploration in the Beaufort Sea of Alaska (LGL Ltd., 1998). It indicated airgun noise of 255 decibels and frequencies from 0-188 Hertz would be used for seismic testing. In relation to the decibel level, the application indicated that fish might be unaffected at distances of 30-33 kilometers (16-18 nautical miles) of seismic activities. (See Section IV.B.1.f(3)(b) - Threatened and Endangered Species, for a further discussion of the characteristics of seismic noise and the difficulty in predicting the effects.) "Ramp-up," which is a gradual increase in decibel level as the seismic activities begin, can help mitigate the effects on fish large enough to move out of their disturbed habitats before damage occurs (Larson, 2002, pers. commun.). Effects on herring, a key prey species, are discussed in the following.

Fish display avoidance reactions to both airgun and vessel sound levels. Finfishes (for example, groundfish, flatfish, rockfish) living near the bottom retreat to the bottom (Pearson, Skalski, and Malme, 1992; LGL Ltd., 1998). These avoidance reactions may be elicited when sound levels exceed fish hearing thresholds by about 30 decibels (Engas and Lokkebord, 2001). McCauley et al. (2000) found finfish begin to show alarm behaviors such as increasing swimming speeds, tightening schools, and moving toward the seafloor at 156-168 decibels re 1 micropascal root mean square. Some finfish observed in this and other studies even exhibited a “C-turn” response where all the lateral muscles along one side of the fish involuntarily contract, and the finfish darts off in that direction. Smaller finfish involuntarily reacted as 182-195 decibels re 1 micropascal mean-peak while larger fishes reacted at up to 203 decibels re 1 micropascal mean-peak. Ironically, their alarm response of descending would take them down where they experience the highest levels of airgun noise.

The same authors found that alarm responses of squid, on the other hand, remained close to the water surface at sound levels 156-161 decibels re 1 micropascal root mean square. Another study found reduced catches of cod and haddock up to 33 kilometers from the seismic testing areas (Engas et al., 1996).
The effects of seismic-wave frequencies on essential fish habitat are less well understood than the effects of decibel levels on essential fish habitat. Recent research indicates that particular frequencies common in seismic waves may cause greater effects than the noise level, especially for the important herring prey of commercial fish species. Finfish can hear frequencies of 100-1,000 Hertz or more (Yoda, Rogers, and Baxter, 2001; Higgs, 2001). The frequency spectrum of sounds produced by geophysical airgun arrays is within the most sensitive hearing frequencies of many marine finfish (Engas and Lokkeborg, 2001). The effects are not only on finfish “ear” bones, but also may affect swim bladders and the lateral line (the line that can be seen along the side of the finfish from head to tail). The frequency of seismic waves apparently could have as large if not a larger effect on essential fish habitat than does the decibel level of seismic waves. The lateral line system is pressure sensitive, and it is likely that many finfish will reveal morphological connections between the lateral line and the swim bladder similar to those recently identified in butterfly fishes (Webb, 2001). By virtue of their anatomy, bottom and littoral fish can hear better than pelagic finfishes (Lychakov and Rebane, 2001) and are more likely to be affected by sound volume. Furthermore, the seismic waves are propagated down more than sideways (and thus are more likely to affect the demersal finfish bottom habitat). The herring is an important forage or prey species of managed fish. Prey must be considered an important EFH component (67 *FR* 2343). Herring (clupeiform fishes) may be particularly sensitive to the frequencies of seismic waves. Herring have a unique “hearing” anatomy connected to the lateral recess (Schilt and Escher, 2001) and may therefore be more affected than other finfishes by seismic waves. Herring are in fact taxonomically defined by their unique “hearing” features such as the characteristic coupling of the swim bladder and inner ear and head canal system (Mecklenburg, Mecklenburg, and Thorsteinson, 2002). Lab experiments indicate another herring species, the American shad, can detect ultrasound up to 180 kilohertz and that they may have evolved this sensitivity in response to predation by echolocating cetaceans (Mann et al., 2001). Mecklenburg, Mecklenburg, and Thorsteinson cited Whitehead (1985) as indicating this “hearing system” probably monitors information necessary for schooling and detection of predators and other hazards. They also indicate that Pacific herring in Alaska reside more offshore in winter and onshore in spring for spawning. Thus, herring, a primary forage prey species, may be most affected by seismic waves as they school and move inshore to spawn. For several species of finfish, it was demonstrated that hearing tissues had not regenerated within 58 days of exposure to seismic airgun energies (McCauley and Fewtrell, 2001). Because of the mechanical hearing damage, fishes may be disoriented and less able to detect predators, and therefore be more vulnerable to predation. Such unnatural opportunities for local predators may adversely impact natural patterns and processes associated with other marine predator populations elsewhere that depend on migratory forage fishes, such as herring, during certain periods of their annual foraging cycle. Section IV.B.1.d(3)(a)4) includes additional details concerning potential impacts of seismic operations to fishes.

IV.B.1.e(2)(a)2) Drilling-Mud and Drilling-Cuttings Disposal

Drilling muds and cuttings may be discarded into Cook Inlet during exploration, if permitted by the Environmental Protection Agency. During exploratory-drilling operations, bulk drilling mud, usually about 100-200 barrels at a time, is discharged several times during the drilling of a well, when the composition of the drilling mud has to be changed substantially or when the volume exceeds the capacity of the mud tanks. Washed drill cuttings and a small volume of drilling mud solids are continuously discharged during drilling operations; the discharge rate varies from about 25-250 barrels per day. Section 403(c) of the Federal Water Pollution Control Act (Clean Water Act) regulations allow only a 100-meter radius mixing zone for initial dilution of discharges in OCS waters. Additionally, the waters of Cook Inlet generally are vertically well mixed and strongly influenced by the tidal cycle. Essential fish habitats (for example, living substrates, prey organisms) are not likely to incur acute (lethal) toxic effects from exposure to permitted discharges within the Federal mixing zone, because (a) the concentrations are of negligible toxicity by the Environmental Protection Agency standards, (b) discharge concentrations of negligible toxicity will become rapidly diluted within the mixing zone by waters of Cook Inlet as they are swept past the discharge point by strong tidal currents, and (c) the timing of drilling discharges in juxtaposition with the presence of considerable numbers of juvenile and adult fishes and prey in the mixing zone for each exploratory or delineation well drilled. Essential fish habitat occurring within the mixing zone may experience sublethal effects; however, these effects are slight and not predicted to impact overall fish populations. Essential fish habitat occurring in or entering the mixing zone during discharge of muds and cuttings may experience lethal and sublethal effects if they are very close (within 1-2 meters) to the discharge point, and volumes of muds and cuttings are released at rates permitted by the Environmental Protection Agency (500-1,000 barrels per hour, depending on water depth). Such lethal and sublethal effects would most likely result from physical damage or smothering resulting from the bulk constituents comprising muds and cuttings. Only very small amounts of essential fish habitat are believed susceptible to such close exposure, due to the limited periods of high discharge rates; the few exploratory wells (totaling seven wells for both sales) to be drilled over a 4-year period; and relative to the widespread distribution of essential fish habitat in Cook Inlet. This activity is not expected to have anything more than negligible effects on essential fish habitat or water quality. See Section IV.B.1.a(2)(a) for additional information on effects to water quality and Section IV.B.1.d(3)(a)1) regarding discharge impacts on fishes.

Essential fish habitat located on the seafloor immediately below the 100-meter mixing zone radius may be temporarily unavailable for fish to occupy because of disturbance from active drilling. It is likely that fish and prey would use the area when drilling activities are not disturbing the seafloor.

IV.B.1.e(2)(a)3) Boat Traffic

Boat trips during exploration are expected to average 160-360 trips per year over 5 years of exploration. However, the amount of boat traffic associated with oil and gas activities are minimal when compared to the fishing and other commercial traffic that occurs within Cook Inlet. Midsized ships such as tugboats and ferries produce sounds of 150-170 decibels filling the frequency band below 500 Hertz (Jasny and Reynolds, 1999). If each trip is 10 hours, temporary displacement of fish from normal habitats (Pearson, Skalski, and Malme, 1992; LGL Ltd., 1998) within the travel corridors could add up to 66-150 days per year. The effects from the oil and gas related boat traffic is expected to have similar effects to those associated with commercial fishing activities. Additionally, an unknown amount of fuel would be deposited in the water by incidental fuel spills.

IV.B.1.e(2)(b) Oil Spills Less Than 1,000 Barrels

See IV.B.1.e(3)(b) for effects of oil spills less than 1,000 barrels

IV.B.1.e(2)(c) Summary of Exploration Effects

Disturbance effects during the exploratory phase are limited to the duration of the actual seismic surveys. The decibel or volume of seismic waves, especially during exploration, will make essential fish habitat temporarily uninhabitable and displace finfish toward the bottom. The noise of seismic waves will cause very short-term (less than 1 week in any one location) Cook Inlet disturbances to essential fish habitat during exploration phases. The effect would be spread out across the lower Cook Inlet multiple-sale area and continue late summer to early fall seasons from 2005-2008. It likely would displace finfish and zooplankton over the same area and duration. The zooplankton would not be displaced but rather could suffer sublethal effects, from which they would recover within one week. See Section IV.C.2 - Lower Trophic-Level Organisms for more detail.

Known effects on essential fish habitat from seismic exploration are considered low. Short-term effects on essential fish habitat from turbidity created during construction of an offshore pipeline are considered low, especially since Cook Inlet waters are naturally high in suspended sediments.

IV.B.1.e(3) Effects of Development and Production

During the development and production stages, effects from disturbances would be similar in type to the effects during exploration. Levels of effects might change somewhat. More seismic surveys might be more concentrated in a particular area. Number of boat trips associated with the development phase would be somewhat lower because the platforms used in exploration also would be used for development. During development and production, the greater risk to essential fish habitat is the construction of offshore pipelines and the potential for oil spills from wells and pipelines.

IV.B.1.e(3)(a) Effects from Disturbances, Discharges, and Noise

IV.B.1.e(3)(a)1) Seismic Surveys

In our hypothetical development-phase scenario, seismic effects would take place only one year, 2009, because we expect a single development. Seismic surveys and their effects in the development phase would be similar to those in the exploratory phase but, because seismic surveys also would be conducted for pipelines from platforms to landfall in addition, more seismic waves would affect the nearshore and intertidal habitats. They would be conducted at moderately higher frequency (Hertz) and lower decibel levels (Larson, 2002, pers. commun.).

Effects on essential fish habitat from seismic surveys conducted during development are considered low. Habitat would recover within minutes after the surveys are completed.

IV.B.1.e(3)(a)2) Offshore Pipeline Construction and Operation

Pipeline construction would result in disturbances to the water column and seafloor in the form of increased turbidity and noise, which can affect prey, prey habitat, and fish habitat. Noise impacts are discussed previously for seismic operations. Observations of dredging operations in other OCS developments show a decrease in the concentration of suspended sediments within a short time (2-3 hours) and distance (a few hundred meters to a few kilometers) downcurrent from the dredging operations (USDOI, MMS, 2001:Section III.C.3.l). If construction of two 25-kilometer-long pipelines (in 2010 and 2022) creates a 2-kilometer-wide plume on either side during the construction season, then a 100-square-kilometer area could be affected. Habitat of sessile organisms and demersal fish larvae could be covered by the plume and would result in smothering of some organisms present. Short-term effects on essential fish habitat from turbidity created during construction of an offshore pipeline are considered low, especially since Cook Inlet waters are naturally high in suspended sediments. A more detailed discussion of turbidity in Section IV.C.1 indicates that turbidity from pipeline construction is expected to be within the natural range of turbidities from silt-laden rivers of Cook Inlet.

Longer-term changes to the benthic and demersal fish habitats on the bottom due to pipeline construction are also likely but only over a small area. As described in Appendix B, pipeline construction is not expected to be a trench although techniques would have to account for the strong currents. These long-term habitat changes can be likened to the type of effects of some bottom trawling fishing gear produce except that pipeline construction disturbances to essential fish habitat would be considerably less in area and less in degree due to a single pass during construction.

Effects are likely to be least in areas of unconsolidated sediments. Unconsolidated sediment is the substrate across the main channel of lower Cook Inlet south from approximately Ninilchik through Kennedy Entrance to the northern tip of Shuyak Island (USDOI, MMS, Alaska OCS Region, 1995:Figure II.A.1-5); that is, in the proposed sale area where dredging to level for pipelines would occur. These unconsolidated sediments are not flat. They tend to form of sand waves or dunes two meters thick over the majority of this area and five meters thick near the northern boundary of Kennedy Entrance (see USDOI, MMS, Alaska OCS Region, 1995:Figure III.A.1-7). In these areas, a pipeline route approximately 3 meters (10 feet) across is likely to be leveled between dunes. Installation would cause somewhat more disturbance deeper across the dunes. With 40 kilometers times 3 meters across (25 miles times 10 feet), the linear disturbance would be limited to approximately 4 hectares (9 acres) of essential fish habitat in 2010 and an additional disturbance of 4 hectares (9 acres) in 2025 is unlikely to have immediate influence. Habitat on this sand and gravel substrate is likely to recover quite quickly. Whether the sand waves move, reform, or do both, is unknown at this time. If the trench does not fill in immediately, additional microhabitat diversity may eventually form in the immediate vicinity because of the trenching.

On the other hand, the northern portion of these unconsolidated sediments, from Ninilchik to the southern tip of the Kenai Peninsula roughly at latitude 59º10' N. (USDOI, MMS, Alaska OCS Region, 1995:Figure III.A.1-7) contains sand waves of 2-15 meters in height producing microhabitat relief that increases the habitat complexity. The effects can be likened to those of bottom trawl fishing. The following information on bottom trawl fishing is summarized from an internal draft for Secretarial Review of the effects of eliminating bottom trawl fishing in the Federal waters of Cook Inlet (USDOC, NOAA, 2002). Trawling can decrease habitat diversity by removing epifauna, smoothing the bottom roughness and removing taxa that produce structure such as burrows and pits. Also applicable to the Alaska situation is the idea that environmental variability, including the composition of the bottom, reduces sedentary megafauna (for example, anemones, soft corals, and sponges). Motile groups (for example crabs and sea stars) show mixed responses. Trenching or, more likely, leveling between dunes for laying pipeline on the bottom would cut deeper into the dunes but over a narrower swath, approximately 3 meters (10 feet) wide, compared to the potential of numerous 6- to 15-meter (20- to 50-foot) wide swaths of bottom-fishing trawls. Thin-shelled bivalves would sustain heavy damage; thick-shelled bivalves, less so. Diatoms, nematodes, and polychaetes would also be affected during construction. Some studies have found that recolonization in disturbed habitat can occur over a relatively short period. Brylinsky et al. (1994) found that nematodes and polychaetes worms returned to their pretrawled levels in less than 7 weeks, and diatoms increased in abundance in troughs within 80 days. In a study by Rumohr and Krost (1991), small epibenthic species recovered to pretrawl densities in 24 hours.

Pipeline construction could disturb or eliminate small amounts of habitat (up to 18 acres) for inner shelf (0- to 50-meter depths) demersal species. These include all capelin life stages; yellowfin sole juvenile and adults; all life stages of sculpin; Atka mackerel egg and adults; all life stages of Pacific cod; Dover sole juveniles; Alaska plaice juveniles and adults; Greenland turbot larvae; arrowtooth flounder at all life stages; rock sole juveniles and adults; rex sole juveniles; flathead sole juveniles; sablefish early juveniles; shark juveniles and adult; and adult octopus. All of these demersal fish use gravel or smaller substrate except sculpin eggs and Atka mackerel eggs. Demersal fish include capelin eggs and adults, sablefish eggs, all stages of Greenland turbot, juvenile and adult sharks, adult eulachon, yellowfin sole juveniles and adults, all sculpin lifestages, Atka mackerel eggs, all Pacific cod lifestages, all stages of arrowtooth flounder, Alaska plaice juveniles and adults, all stages of rocksole and flathead sole, Dover sole juveniles, arrowtooth flounder juveniles and adults, rex sole adults, yelloweye rockfish juveniles and adults, thornyhead rockfish juveniles and adults, and all stages of skates.

Also affected by habitat change are fish whose habits are semidemersal, living both on the bottom and in the main water column over the continental shelf (1-200 meters deep). These semipelagic/semidemersal fish include walleye pollock juvenile and adults, northern rockfish juveniles and adults, shark juvenile and adults, as well as adult stages of capelin, Atka mackerel, eulachon, squid, Pacific ocean perch, dusky rockfish, shortracker and rougheye rockfish, sablefish early juvenile, and all stages of Greenland turbot. The small amounts of disturbed fish habitats are likely to be recolonized within 3 years. As discussed in the lower trophic-level organisms Section, IV.B.3, prey at the low levels of the food chain such as diatoms and polychaete worms would recover within 1-80 days.

IV.B.1.e(3)(a)3) Boat Traffic

The number of boat trips associated with the development phase would be somewhat lower than in the exploration phase, because the platforms used in exploration would also be used for development. The effects of the oil and gas related boat traffic would have similar effects to those associated with commercial-fishing activities.

IV.B.1.e(3)(a)4) Onshore Pipeline Construction and Operation

Onshore, up to 75 miles of oil pipeline may need to be constructed from the landfall north of Anchor Point to the Nikiski oil and gas complex either in existent or anticipated pipeline corridors near the Sterling Highway. While an exact route cannot be established, the pipeline route would have to comply with the following Alaska Coastal Management Plan policies, as outlined in Sections IV.B.1.s(3)(d) and IV.B.1.s(3)(e). The landfall would avoid sensitive aquatic habitat. The route for the pipeline would be sited inland from shorelines and beaches, and pipeline crossings of anadromous fish streams would be minimized and consolidated with other utility and road crossings of such streams. Pipelines would be buried wherever possible and sited in existing rights-of-way for other utilities or transportation systems wherever possible, such as that provided by the Sterling Highway. The pipelines would designed, constructed, and maintained to minimize risk to essential fish habitats from a spill, pipeline break, or other construction activity. Therefore, impacts to essential fish habitat are expected to be negligible.

IV.B.1.e (3)(b) Oil Spills Less Than 1,000 Barrels

Small oil spills (less than 1,000 barrels) are not expected to affect the overall quality of Cook Inlet water (see Section IV.B.1.a on water quality effects). They would degrade the water quality for up to 10 days in areas less than 50 square kilometers. Small spills may adversely affect individual prey organisms (including some fisheries resources) but not overall populations (see Sections IV.B.1.d(3)(b) - Fisheries Resources and IV.B.1.c - Lower Trophic-Level Organisms). Concentrations of petroleum hydrocarbons in most fish habitats would render some prey organisms toxic for a short distance from the spill location after a spill event (see Section IV.B.1.d - Fisheries Resources).

However, many fish species are more susceptible to stress and toxic substances at the egg and larval stages than adult stages. Several studies demonstrated adverse effects of oil to intertidal fish habitat at levels below the water quality guidelines of 15 parts per billion, including mortality to pink salmon embryos at 0.1 part per billion (Heintz, Short, and Rice, 1999). Their study found a 25% reduction in survival during incubation of brood fish exposed to less than 18 parts per billion. Between the end of the exposure and maturity, survival was further reduced by another 15%, resulting in the production of 40% fewer mature adults than the unexposed population. Thus, the true effect of the exposure on the population was 50% greater than was concluded after evaluating the immediate effects. Studies indicate that examination of short-term consequences underestimate the impacts of oil pollution (Heintz et al., 2000). When oil contaminates natal habitats, the immediate effects in one generation may combine with delayed effects in another to increase the overall impact on the population. If small spills enter intertidal habitats, thousands to millions of egg and larval habitats could be impacted and last for multiple generations of a subpopulation. However, impacts would affect only subpopulations and would not result in a significant impact to an overall population inhabiting the central Gulf of Alaska. (See Sections IV.B.1.d(3)(b) and IV.B.1.e(3)(c)1) for additional information about oil-spill effects.)

Intertidal habitat of capelin eggs and adults, herring eggs, sculpin eggs and adults, yellowfin sole and pink salmon eggs, adult squid, juvenile sablefish, walleye pollock larvae and adults, Pacific cod larvae and adults, eulachon juveniles, and Greenland turbot eggs could experience such adverse effects.

Numerous marine fish species have pelagic egg and larval stages within the project area and may be adversely impacted by small oil spills. Large numbers of juvenile fish, floating eggs, and larvae may be killed when contacted by oil (Patin, 1999). Individuals inhabiting pelagic habitats in the project area and exposed to small oil spills may experience lethal or sublethal effects similarly described above for intertidal habitats. However, the numbers of individuals and generations impacted may be lower because organisms inhabiting intertidal habitats may receive repeated, long-term exposure, while organisms inhabiting pelagic habitats are believed more prone to acute toxicity exposures.

IV.B.1.e(3)(c) Oils Spills Greater Than or Equal to 1,000 Barrels

Section IV.B.1.d(3)(b) describes potential oil-spill impacts to fisheries resources that include some important prey species. Depending on the frequency and distribution of small spills, large oil spills probably pose the greatest risk to essential fish habitat, should one occur. Modeling based on historical oil-development activities indicates that an oil spill greater than or equal to 1,000 barrels has approximately a

19% chance of occurrence. Before such an oil spill of this size occurs as a result of the Proposed Action, it is important to understand its potential consequences.

We estimate a 19% chance of one or more large oil spills greater than 1,500 barrels from a production facility or greater than 4,600 barrels from a pipeline occurring over the life of the project. The 3,100-barrel *Glacier Bay* spill near Nikiski in 1987 is roughly halfway between the two hypothetical spill sizes.

The *Glacier Bay* spill dissipated within 3-7 days of the spill. According to the Federal On-Scene Coordinator's report on the spill (U.S. Coast Guard, 1988), approximately 1/4 mile of beach was oiled near the spill, and 1/2 mile was oiled across Cook Inlet on the west side. Two creeks in Kamishak Bay were boomed off to prevent injury. Approximately 63,000 pounds of sockeye salmon were rejected for processing due to contamination by oil from the *Glacier Bay* spill that season. One year after the *Glacier Bay* spill, no wetlands or spawning streams appeared to have been affected by the oil spill. Minor amounts of tarballs were reported ashore on the north and east sides of Kalgin Island and in the vicinity of Clam Gulch on the east side of Cook Inlet.

In contrast, the sizes of these hypothetical spills are less than 2% of the size of the 257,000-barrel, 1989 *Exxon Valdez* oil spill in Prince William Sound, and the expected effects are believed to be smaller. A recent survey of remaining North Slope Alaska crude oil from the much larger (about 83 times larger) *Exxon Valdez* oil spill in Prince William Sound found unexpectedly high levels of oil with little weathering, after more than a decade. The most detailed indicator of fish habitat recovery is the status of resource recovery as classified by the *Exxon Valdez* Oil Spill Trustee Council (2002), which is summarized in the following.

The intertidal communities are considered to be recovering but not fully recovered from the effects of the oil spill, based on the lack of full recovery of some soft-sediment intertidal invertebrates as well as the continued presence of residual oil and based on the role of oil in initiating *fucus* seaweed population instability. That is, a different species of *fucus* seaweed took over and does not provide the same quality of habitat in some oiled areas.

Sediments are presently considered to be still in the process of recovering. Four and five years after the spill, surface and subsurface oil mousse persisted in a remarkably unweathered state on five of six boulder beaches. The year of the spill, oil in sediments below the tideline was mostly confined to the uppermost 20 meters water depths (below mean low tide), although elevated levels of hydrocarbon-degrading bacteria associated with elevated hydrocarbons were detected at depths of 40 and 100 meters in Prince William Sound. After four years there was little evidence of *Exxon Valdez* oil and related elevated microbial activity at most index sites except at those associated with sheltered beaches that were heavily oiled in 1989. Those sites are among the few sites at which substantial subsurface oiling is still known to occur. The classification of recovering was based on this information. However, the presence of surface and subsurface oil continues to expose and potentially harm living organisms.

Recovery of the shallow subtidal community is considered unknown. Animal community composition in oiled areas, especially in association with eelgrass beds is somewhat different from comparison sites and it is not known whether this is due to the influence of natural factors or to oil effects or some combination. Studies conducted on intertidal and subtidal communities in relation to oiling and shoreline treatments indicate that intertidal fauna dwelling in soft sediments, including various clam species, had recovered to some extent within 1-3 years after 1989 on oiled but untreated shorelines. As of 1997, full recovery had not been achieved, especially on shorelines that were oiled and treated by hot-water washes. One study found that densities of littleneck and butter clams were depressed through 1997 on oiled, treated mixed-sedimentary shores where fine sediments had been washed downslope during pressured water treatments.

Comparing oiled study sites on Knight Island with unoiled sites on Montague Island, researchers in the Nearshore Vertebrate Predator Project found a full range of size-classes of clams at the oiled sites, as well as more large clams. However, oiled sites also had fewer juvenile clams and lower numbers of several species. Based on the above-summarized evidence, clams continue to be classified as recovering, but not yet fully recovered from the effects of the oil spill.

Mussels are an important prey species in the nearshore ecosystem throughout the spill area and are locally important for subsistence. Beds of mussels provide physical stability and function as essential fish habitat in the intertidal zone and were purposely left alone during *Exxon Valdez* cleanup operations. In 1991, high concentrations of relatively unweathered oil were found in the mussels and in underlying byssal mats and sediments in certain dense mussel beds.

About 30 mussel beds in Prince William Sound still contained *Exxon Valdez* oil residue when last sampled in 1995. Twelve of these beds had been cleaned on an experimental basis in 1993 and 1994. In 1995, oil hydrocarbon concentrations in mussels at half the treated beds were lower than would have been expected if the beds had not been cleaned. In 1996, however, limited sampling indicated that several of the cleaned beds had been recontaminated from surrounding or underlying oil residue.

Mussel beds along the outer Kenai Peninsula coast, the Alaska Peninsula, and Kodiak Archipelago were surveyed for the presence of oil in 1992, 1993, and 1995. In 1995, hydrocarbon concentrations in mussels and sediments at these Gulf of Alaska sites were generally lower than for sites in Prince William Sound, but at some sites substantial concentrations persisted. While several sites in Prince William Sound still contained high concentrations of oil in 1995, over half the sites surveyed demonstrated significant natural declines that suggest background concentrations should be reached in the next few years. Oil contamination in mussels, however, likely will persist for many years at certain sites that are well protected from wave action or where oil penetrated deeply into underlying sediments.

The latest available data, taken in 1999, indicate that oil is still accumulating in mussels. Since the latest available data indicate that *Exxon Valdez* oil remains in mussels, they are classified to be recovering from the oil spill, but not yet recovered.

The recovery of the fish species that were followed after the oil spill is as follows:

- Cutthroat Trout - Unknown
- Dolly Varden - Unknown
- Pacific Herring - Not recovering
- Pink Salmon - Recovered
- Rockfish - Unknown
- Sockeye Salmon Recovered

The MMS oil spill model is run to determine the most likely areas that oil spills might affect. While the model is considered state-of-the art, it is important to understand that our knowledge of the complex circulation and weather patterns in Cook Inlet upon which the model is based is rudimentary. For example, our knowledge of tide rip location (USDOI, MMS, 2000), and even more our knowledge of how to model the complex mixing of oil into and out of the rips is rudimentary. The prediction of how much oil will contact which locations is a simulation based on averages of known weather and current patterns. The actual behavior of a real oil spill could be extremely different given the particular currents and weather at the time of a spill. Appendix A gives a more detailed description of how the oil spill model works.
The model predicts that the chance of freshwater resources being contacted within 10 days is less than 5%. The model also indicates a majority of the oil trajectories destined to contact shoreline will do so within 10 days, due to the enclosed nature of the shoreline of Cook Inlet (Appendix A). However, to make the small differences between lease sale alternatives more apparent, this evaluation will consider the model prediction of oil location after 30 days. Tables III.B-7 through III.B-18 summarize the risk to essential habitat after 3, 10, and 30 days, if a large oil spill were to occur.

IV.B.1.e(3)(c)1) Intertidal Beach and Bay Habitats

As happened in the 1989 *Exxon Valdez* oil spill in Prince William Sound, habitats most likely to sustain long-term impacts of up to a decade are beaches and intertidal habitats. Oil from the *Exxon Valdez* oil spill continues to contaminate beach and intertidal habitats in Prince William Sound for more than a decade (Short, 2002). Reduced reproductive success, acute consequences at a population level (defined differently than used in our analysis) and the enhanced susceptibility to disease that occurred four years after the spill are attributed to degradation of intertidal and shallow subtidal habitat for spawning herring by oil (Peterson, 2001).

Egg and larval stages of many species are more susceptible to stress and toxic substances than adult stages. Several studies demonstrating adverse effects of oil to fish are described in Section IV.B.1.d(3)(b) (Fisheries Resources) and Section IV.B.1.e(3)(b) (Oil Spills Less Than 1,000 Barrels). A large oil spill in the proposed action area may adversely impact fishes and essential fish habitat, including prey species, with lethal and sublethal effects. The effects may result in mortality to prey species of vary life stages that the oil slick cloaks, or lead to reduced fitness, survival, or fecundity leading to multiple generational effects. A large oil spill may adversely impact billions of local organisms regarded as essential fish habitat; however, such impacts are only expected to effect specific cohorts and subpopulations of the region and not an overall population in the central Gulf of Alaska.

The oil spill trajectory model predicts that the majority of the coastal regions have less than a 20% chance of being contacted within 30 days should a large oil spill occur. The greatest likelihood of spilled oil contacting any of the coastal beaches and intertidal areas is a 2% chance in the upper Shelikof Strait and in Kamishak Bay. The least-likely beach sections to be contacted are along the western side of lower Cook Inlet and the outer Shelikof Strait area (along the Alaska Peninsula beyond Wide Bay and Kodiak Island; see Map A-3).

Fish habitats that would be affected when oil contacts the beach include habitat for sculpin of all ages, capelin eggs and adults, adult yellowfin sole, Pacific sand lance eggs, larvae, and adults, and spawning herring and eggs. Table IV.B-9 indicates that in the unlikely event that an oil spill occurs, these habitats would have less than a 20% chance of being oiled. However, the beached oil could persist for more than a decade. The eggs and sculpins would have little chance of avoiding the oil because of their size. The smaller yellowfin sole, which reaches a length of only 19 inches (49 centimeters) at maximum, could be lost but the capelin adults should be able to avoid the oil. Intertidal and beach sediments that are utilized as preferred habitat by Pacific sand lance and contaminated by spilled oil will no longer be available to sand lance since this species is known to be sensitive to and avoid oiled substrates (Pinto et al., 1984). Such habitat loss may persist for decades until residual oil levels subside below that detectable by sand lance. Pacific sand lance are one of the most important prey fishes for sea birds and marine mammals in Cook Inlet and the central Gulf of Alaska area.

Maximum tidal range varies from 7.6-8.8 meters (25-29 feet) in lower Cook Inlet to 3 meters (10 feet) in Sitkinak Lagoon on the south side of Kodiak Island. Thus, the most extensive intertidal flats are in the major bays of western lower Cook Inlet, specifically, in southwest Kamishak Bay, Chinitna Bay, Tuxedni Bay, and Iniskin Bay. Another extensive tidal flat extends south from Kalgin Island. The Kenai River in eastern lower Cook Inlet has a notable but less extensive intertidal area. Shelikof Strait and Kodiak Island have minimal intertidal beaches.

If a large oil spill originates from LA's 1 and 2 (Map A-4 Spill Areas and Pipelines), Kamishak Bay is most vulnerable to spilled oil, where there is up to an 18% chance that beaches and intertidal areas would be impacted in summer and up to a 19% chance in winter.

Intertidal habitat of Pacific sand lance and capelin eggs and adults, herring eggs, sculpin eggs and adults, yellowfin sole and pink salmon eggs, adult squid, juvenile sablefish, walleye pollock larvae and adults, Pacific cod larvae and adults, eulachon juveniles, and Greenland turbot eggs could be adversely affected.

IV.B.1.e(3)(c)2) Estuarine Habitat

Lower Cook Inlet is considered an estuary of the Gulf of Alaska, connected to the open sea but diluted with freshwater. The largest variation in salinity and suspended sediment that affects EFH results from freshwater inputs from upper Cook Inlet. Generally, freshwater inputs from large rivers such as the Susitna, Knik, and Matanuska rivers decrease salinity and increase suspended sediment loads along the west side of lower Cook Inlet.

Subtidal habitats from 15-60 meters in depth in Prince William Sound were adversely affected to the extent that demersal fishes exhibited effects such as elevated levels of stress hormones 1 and 2 years after the *Exxon Valdez* oil spill (Peterson, 2001).

The finfishes typically inhabiting bays and estuaries include mostly juveniles: herring, rocksole, salmon, eulachon, squid, sablefish, and Pacific cod. These bays also provide habitat for larvae of three species—squid, walleye pollock, and Pacific cod; and adults of four species—walleye pollock, herring, Pacific cod, and yellowfin sole. The adults are most able to avoid oil by moving into other unoiled habitat. The larvae are less able to move to avoid oil; that is, in a sense, their entire essential habitat is more likely to be oiled. There are a few more conclusions that can be made about potential effects of oil on estuarine salmon habitat than about the habitat of other less studied species. Smolted juvenile salmon that are just entering

Cook Inlet from freshwater streams, apparently reside in habitat near the water surface for some time in upper and lower Cook Inlet, moving back and forth between the two areas (Moulton, 1994). Because of their small size, less than about 4 inches, they would be less able to escape an oil spill and more likely to ingest oiled prey.

In habitats near Kodiak Island, higher levels of feeding by maturing sockeye salmon in the few months prior to spawning are associated with greater distance or travel time from natal streams (Tyler et al., 2001). Nonlocal sockeye would be at greater risk of contamination via ingestion than local fish. Sockeye near their natal stream would be at the least risk, as feeding has nearly ceased.

The Cook Inlet waters are primarily an estuary, because large amounts of fresh water drain into the Inlet. As might be expected with water flowing out of upper Cook Inlet, if an oil spill occurs, the risk is greatest in the lower half of the lease sale area. The waters along the western coast of Kodiak Island are most at risk (up to a 34.5% chance), the deep waters of Kennedy Entrance have the second greatest chance (up to 33.9%) of being affected by an oil spill. Kamishak Bay (west side) and the Kenai Peninsula have the third greatest risk of being affected. Estuarine waters on the western side of lower Cook Inlet are least likely to be contacted by an oil spill. The concentration of oil in the water column of the oiled estuarine areas would be expected to decrease to below the regulatory criterion of 15 parts per billion within 30 days.

IV.B.1.e(3)(c)3) Marine Water Habitat

Any oil that reaches the Gulf of Alaska outside the Barren Islands, Kennedy Entrance, and Kodiak Island boundary waters is likely to have been weathered for at least 10 days and, therefore, would be less toxic. Epipelagic fish habitats affected are roughly those of the arrowtooth flounder larvae and juveniles, yelloweye rockfish larvae, skate larvae, and Alaska plaice larvae that inhabit waters over the continental shelf of depths from 0-200 meters. The concentration of oil in the water column of the oiled marine areas would be expected to decrease to below the regulatory criterion of 15 parts per billion within 30 days. Small eddies could be an exception to the rapid dispersion of oil in other marine waters. Small eddies are a circulation feature in Shelikof Strait that turns up only in fine scale analysis and oil spill modeling would not include the eddy circulation. Small circulating eddies can be important to early life history stages of walleye pollock carrying high concentrations of pollock larvae in better condition (Schumacher and Stabeno, 1994). Warmer temperatures and increased winter precipitation (as would be expected with global warming) would tend to increase eddy formation during the spring, and there may be a tendency for flows onto the shallow shelves adjacent to the sea valley, which may be nursery grounds for pollock larvae in Shelikof Strait (Stabeno et al., 1995).

Eddies are likely to retain oil as well as pollock larvae and other zooplankton concentrated at a depth of 30 meters. The mixing and retention of oil to the 30-meter depth is likely to occur more rapidly in the eddies than the 30 days it takes for oil to mix to 30 meters in surface waters. Pollock larvae eddy habitat will be more degraded by an oil spill than most other habitat and the concentration within the eddies could be above the regulatory criteria of 15 parts per billion for 30 days or longer The pollock larval stage lasts 20-50 days (Brodeur and Wilson, 1996).

Demersal fishes, including flathead sole yellowfin sole, rockhead sole and walleye pollock, that range up to 640 kilometers into the deep waters of the Gulf of Alaska from Prince William Sound, had biochemical indicators of oil detoxification processes at least 2 years later (Peterson, 2001) demonstrating that somewhere along the timeline that their habitat was degraded.

Marine waters of the Gulf of Alaska seaward of the Kodiak and Barren Islands generally have less than 0.5% chance of being oiled, even in the event that a large oil spill occurs. Oil-spill modeling indicates that oil spilled from a platform would most likely be pushed into the marine waters seaward of Kennedy Entrance (up to a 6.8% chance) and seaward of the Kenai Peninsula (up to 3.9%). A pipeline rupture is less likely to impact marine waters.

IV.B.1.e(4) Prey, Prey Habitat, and Other Ecosystem Components

Another portion of essential fish habitat that must be analyzed under the Sustainable Fisheries Act is “prey species, their habitat, and other ecosystem components.”

The Essential Fish Habitat regulations (67 *FR*, 2343) define ecosystems as "communities of organisms interacting with one another and with the chemical and physical factors making up their environment," And note that a healthy ecosystem "retains the ability to regulate itself." Sections IV.C.1, IV.C.2, and IV.C.3 evaluate effects on water quality, lower trophic-level organisms, and commercial fisheries. This section will evaluate the effects on Habitat Areas of Particular Concern and forage fish communities as a component of essential fish habitat.

As stated earlier, the primary risk of adverse effects to essential fish habitats from this lease sale is the potential of a large unlikely oil spill. The National Research Council reviewed the amounts of petroleum inputs into oceans and effects of all these inputs, including oil spills (National Research Council, 2002). The following paragraphs, summarized from that document, demonstrate ways in which oil spills may affect both habitat areas of particular concern such as corals (referred to as biogenically structured habitats) and an ecosystem's ability to regulate itself can be affected by an oil spill.

Biogenically structured habitats, such as salt marshes where plants and animals are habitat for other organisms, are subject to destruction or alteration by acute oiling events. Indirect effects can be substantial. For example, in the *Exxon Valdez* oil spill (in Prince William Sound) and the *Torrey Canyon* oil spill (off the coast of southeast England), destruction of the algal cover had indirect impacts on limpets and other invertebrates. Such successional, reverberating or cascading indirect effects in a complex ecosystem may be very important but are not captured by laboratory studies.

Fresh petroleum is readily oxidized by microbes, which in turn can serve as a supplementary food source for benthic food webs in shallow water. The decrease in oxygen in the surface layers of the sediments that results from microbial metabolism of petroleum is a limiting factor to benthic organisms.
Medium and higher molecular weight aromatic compounds are among the most persistent compounds in both animal tissues and sediments. The half-lives in marine bivalves can be quite long compared to the relatively rapid decline in monoaromatic compounds. Hydrocarbon exposure can occur at concentrations several orders of magnitude lower than concentrations that induce acute toxic effects. Impairment of feeding mechanisms, growth rates, development rates, energetics, reproductive output, recruitment rates, and increased susceptibility to disease are some examples. Early developmental stages can be especially vulnerable. Heintz, Short, and Rice (1999) reported embryo mortality of pink salmon with laboratory exposure to aqueous total polycyclic aromatic hydrocarbon concentrations as low as 1 part per billion.

Prey and prey habitats compose the next level of the fish food web. The primary prey in the Cook Inlet area is zooplankton swimming in the open estuarine and marine waters, benthic animals in the estuarine zone and on the shallow sea bottom, and smaller fish categorized as forage fish. Consuming oiled zooplankton prey has been identified as a likely avenue of oil exposure in fish in the *Exxon Valdez* oil spill (Peterson, 2001). Euphausiids are the most important planktonic prey in oceanic and shallow coastal waters but primarily occur in upwelling waters such as the Kennedy Entrance and at the edges of the Shelikof gully. Copepods are a secondarily important prey. The species that depend on these zooplankton include walleye pollock, Atka mackerel, sablefish rockfish and flatfish, salmon, capelin, eulachon, and Pacific herring. In western Gulf of Alaska areas, euphausiids make up more than 70% of the total consumption of walleye pollock, the dominant small fish prey of larger fish. Copepods and euphausiids more than 85% in weight of age-0 pollock diet (Cianelli and Brodeur, 1997). See Section IV.B.1.c – Lower Trophic-Level Organisms for more details on the effects of this lease sale on euphausiids and copepods.

As the complex food web is incorporated into the essential fish habitat analysis, we must begin to take ecosystem functioning into account. While there are no Federal offshore oil and gas developments in Cook Inlet at this time, ecosystem-level changes in essential fish habitat are occurring in Cook Inlet from commercial fishing, sports fishing, urban development, shipping, and other commercial developments within the area. Potential effects of this oil and gas lease sale on the ecosystem components are difficult to separate from the causes of the changes that are already taking place. This is especially true when analyzing the potential effects of this sale on forage fish.

Forage fish are the major prey analyzed as part of essential fish habitat. Forage fish are by definition prey for other animals. However, this simple definition would include, in all probability, all species at some stage of their life cycle. But forage fishes do not include all the species, only a small subset. Therefore, forage fishes are abundant, schooling fishes preyed upon by many species of seabirds, marine mammals, and other fish species. They provide critical ecosystem functions by transferring energy from primary or secondary producers to higher trophic levels (Springer and Speckman, 1997). The structure of the forage fish community is a critical component of the ecosystem. The community relationships are complex. A number of commercial fish species such as salmon, cod, and halibut feed on forage fish. A number of forage fish, such as pollock and herring, are also commercially valued fish species. Adult forage fish, such as pollock, also prey on the young of their own species. Many forage fish and commercial fishes also prey on the euphausiids and other zooplankton during at least one of their life stages. Zooplankton sometimes feed on the larval stages of forage and commercial fish. This complexity is especially exemplified by walleye pollock, a key species in the proposed sale area (see Figure III.B-7). Because of its importance as a key species in the ecosystem, pollock will be discussed in detail later in this section.

Capelin is a major forage fish in the northeast and southwest of Kodiak Island. Spawning occurs in spring in intertidal zones of coarse sand and fine gravel, especially in Kodiak, and capelin overwinter in the bays of Kodiak Island and in Kachemak Bay (National Marine Fisheries Service, 1999).

Eulachon, Pacific herring, Pacific sand lance, and capelin also are important forage fishes. Eulachon are consistently identified by groundfish fisheries and surveys in Shelikof Strait in the Gulf of Alaska (National Marine Fisheries Service 1999).

Herring is one of the species that experienced a population crash after the *Exxon Valdez* oil spill in 1989 in nearby Prince William Sound. The most common forage fish caught in Cook Inlet sampling gear was by far herring (USDOI, MMS, 1999) in depths less than 10 meters.

Until recently, there was no obvious mechanism by which an oil spill would impact herring adults. However, in the late 1980's, herring were noted coming to the surface to gulp air (Thorne and Thomas, 1990), and this behavior in the midst of an oil spill has been hypothesized to help explain the immediate deaths and secondary susceptibility to pathogens of Prince William Sound herring years after the *Exxon Valdez* oil spill. Thus, the surface may also be habitat and could be more directly affected by an oil spill than slightly deeper depths. Furthermore, as the water quality section, Section IV.B.1a(4)(b) - Oil Spills Less than 1,000 Barrels explains, 25% of the oil mixes into the top 5 meters within 3 days, 37% of the spilled oil mixes within the top 10 meters after 10 days, and 42% mixes within the top 30 meters after 30 days.

The most detailed geographic herring information is for herring spawning locations in Kamishak Bay (see Map 5). The largest spawning aggregation in the proposed lease sale area is in Kamishak Bay. They spawn mid-April to the first week of June. Biologists believe the adults do not stay in Kamishak Bay long after spawning and that the young are flushed out of Kamishak Bay; conventional wisdom is that their winter habitat is off the coast of Shelikof Strait (Otis, 2002, pers. commun.).

Less information is known about the other stocks of herring (Gretsch, 2001). Habitat near Kodiak island is found in every bay from the northern tip of Afognak Island south to Uganik Bay midway down the western Kodiak Island that supports herring. The bays and habitat within about 0.8 kilometer (1/2 mile) of shore seem to be heavily used year-round (Gretsch, 2002, pers. commun.). While much of the herring spawning takes place in intertidal areas, there also appears to be a considerable use of subtidal areas near Kodiak Island as well (Gretsch, 2001). Effects on herring habitat would be similar to the effects on other intertidal, beach, and estuarine fish habitats discussed above. If herring are actually impacted by a large oil spill as hypothesized above, effects on the herring stock in the Kamishak Bay area could be a moderate impact lasting longer than 3 years.

Those forage species that are commercially fished—pollock, herring, and capelin—are the species for which we have the most knowledge of their prey and predators. The other forage species identified by the North Pacific Fisheries Management Council as components of essential fish habitat because they are prey species may be as important and intricately enmeshed in the food chain but simply not yet documented as such. We know so little about them that they were grouped, not as individual species but as families of species (see Table III.B-1) by the North Pacific Fisheries Management Council when the council identified essential fish habitat. These families include Pacific sand lance, lantern fish, deep-sea smelt, sand fish, gunnel, prickleback, and bristlemouth families, all unfamiliar to most of the residents of Cook Inlet. In part, the lack of information regarding these species may be because pollock and herring are of commercial interest, while the other species are not currently regarded as economically appealing in the region.

Lack of detailed study does not mean that they are not important, however; for example, recent evidence indicates that declines of seabirds—murres and black-legged kittiwakes—at Chisik Island near the northeastern corner of the lease area, may be related to declines of sand lance (Robards et al., 2000).

As noted earlier, walleye pollock is a important forage fish species in the lease area. Many species depend on a pollock lifestage as their primary prey. Pollock seems to be a key species in the lease sale area. What happens to pollock impacts many other species and ecosystem functions in a critical manner.

Pollock play a critical and very complicated role in the food web, being both prey and predator. For example, pollock eggs are prey for gammarid and euphausiid zooplankton, and then, gammarids and euphausiids become prey of juvenile pollock. Predators of juvenile pollock include marine mammals, birds, and other fish species, as well as adult pollock. Figure III.B-7 (taken from Brodeur, Wilson, and Napp, 1996) illustrates this complicated relationship in the early life stages of the pollock. The Shelikof Strait region is a very important area to the early life history of the pollock population inhabiting the central Gulf of Alaska. In most years, Gulf of Alaska pollock recruitment is largely set during the life stages that take place in Shelikof Strait (Kendall, Schumacher, and Kim, 1996).

Walleye pollock is the main (up to 80%) forage fish prey in the Gulf of Alaska for the groundfish arrowtooth flounder, Pacific halibut, sablefish, and Pacific cod as well as a few adult walleye pollock (in other regions adult pollock are a major predator that cannibalizes smaller pollock). Most of the adult pollock in the Gulf of Alaska comprise one stock that migrates to the deep areas, greater than 250 meters in Shelikof Strait "gully" for spawning (Kendall, Schumacher, and Kim, 1996). This deep gully straddles the western Shelikof Strait and the western Kodiak Island areas identified for the essential fish habitat analysis (Map 3).

Megrey et al. (1995) found that Gulf of Alaska pollock survival from egg to 2 year olds when they are large enough to be caught in the commercial fishery is statistically related to precipitation (that is hypothesized by Stabeno et al., 1995 to cause small-scale eddies), to wind mixing and large-scale ocean-pressure gradients.

Since the 1980's, the pollock population had dropped dramatically. Due to low stock abundance, the 2002 Cook Inlet fishery for pollock is closed (see Section III.C.2.d on the groundfish fishery). The stock is at an all-time low and is projected to decline into 2002. Most recent year classes appear to be weak, and consequently, spawner biomass is expected to decline through at least 2003 (North Pacific Fishery Management Council, 2001).

Predators may be more sensitive to changes in pollock abundance, and their predator population dynamics may be more easily correlated with the abundance of a single species (Byrd et al., 1996) such as pollock. Pelagic juvenile pollock are usually the dominant prey of fish-eating seabirds. Pollock comprised 72-86% of the diets of adult tufted puffins, horned puffins, common murres, pigeon guillimot (Byrd et al., 1996) in an eastern Aleutian study near Shelikof Strait.

As described, this species, critical both to commercial fisheries and to the food web, is particularly susceptible to oil spills in which oil is concentrated in the same eddies as pollock larvae. Eddies are correlated with high larval pollock survival (Schumacher and Stabeno, 1994), which in turn is correlated with adult recruitment to the pollock fishery (Kendall, Schumacher, and Kim, 1996). Thus, oil spills that affect pollock also indirectly affect all the species that feed primarily on Pollock and their competitors. Hence, moderate changes to the population dynamics of pollock in the central Gulf of Alaska may result in major adjustments in the trophic dynamics of the region's ecosystem causing population adjustments of many marine fauna. Consequently, the effects on forage fish may be our best indicator of effects on the "communities of organisms interacting with one another" that make up essential fish habitat and the ecosystem.

Damage to herring primarily in Kamishak Bay, may be another example of an adverse effect on habitat. Seismic noise in wavelengths that damage hearing organs could reduce their survival, but seismic activities are only expected to occur a couple times during the period. In addition, if the herring rise through oiled water surfaces to gulp air or ingest oiled zooplankton (Peterson, 2001), they can suffer directly from toxic effects of spilled oil. Ingested oil may make them more susceptible to diseases that can greatly reduce their population. These effects could indirectly decrease their survival. Because they are prey for so many other fish their decrease in number and quality would constitute a degradation of essential fish habitat and because they are prey for many birds and marine mammals, the effects also could radiate up the food chain.

Potential effects of this lease sale or any other development depend on the "regime"—conditions and community or ecosystem structure–present at the time. The Cook Inlet commercial and forage fish community and the prey of the forage fish in Kachemak Bay (Bechtol, 1997) and Shelikof Strait (Anderson et al., 1997) experienced a "regime shift" since the early 1970's.

Since 1976, fish composed an increasing portion of the mean catch weight in Kachemak Bay shrimp surveys (Bechtol, 1997). Pollock appears to have been a dominant species in the Kachemak Bay ecosystem. As the shrimp population declined in the 1980's, the fish component of the survey catch increased dramatically from less than 20% to more than 80%. Walleye pollock always dominated the forage fish catch but their number and range varied widely. They generally trended toward fewer fish (decreasing by two orders of magnitude) spread throughout a greater area (in 22% of tows up to being in 90% of tows). This trend may be a result of a large number of small, young fish growing into fewer but widely distributed large, old fish.

The term "regime shift" is most often associated with the changes in the North Pacific that have resulted in many years of increased salmon runs in Alaska since the early 1970's and a corresponding reduction of salmon runs in Washington and Oregon over the same period. Implicit in the concept of regime shift is that changes occur throughout the ecosystem and a new community structure is formed (Anderson et al., 1997). Results suggest the Bering Sea ecosystem may not have returned to initial conditions after the change in physical state that occurred around 1978 (Decker et al., 1995). It is possible that the ecosystem has now reached a relative stability in which predator species suppress the production of prey species that are limited in abundance. The changes in Kodiak have been correlated with a March nearshore temperature change of about 2 °Celsius that allow cod to remain in the bays through winter instead of migrate offshore (Anderson et al., 1997). While 2 ºCelsius seems like a small change, it can result in a very significant ecological change, especially in cold northern ecosystems.

It is possible that the ecosystem has now reached a relative stability in which predator species suppress the production of prey species that are limited in abundance (May, 1977; Bechtol, 1997).

However, there are many potential stable states an ecosystem can settle into (May, 1977). The shift near Kodiak Island occurred rapidly and may shift again from a fish-dominated to another community regime (Anderson et al., 1997).

A major shift in predator-prey dynamics may be caused by an oceanographic change in fish habitat such as a large temperature increase of around 2 degrees near Kodiak Island during 1 or 2 months over a few successive years (Anderson et al., 1997). The change in Kachemak Bay, for instance, may be a structural change where predatory species now keep forage fish species cropped to a lower total population spread over a larger range (Bechtol, 1977). Whether that temperature increase near Kodiak Island is a short-term natural variation in local temperatures or a local temperature change caused by global warming, it may be the cause of a substantial change in the fish habitat.

However, such change could also have been triggered or accentuated by a physical or biological change in fish habitat such as the collapse of a single key species prey population (for example, pollock) or surges in predatory fish, bird and mammal species. A high proportion of ecosystem energy probably flows through the age-0 pollock. Recruitment models of pollock indicate that most of the interannual variability in mortality occurs during the passage from larvae to early juveniles (Cianelli and Brodeur, 1997). Thus, changes in the age-0 pollock population could trigger or accentuate structural changes in fish habitat.

Two other potential causes of community structural change are overfishing and the accumulation of smaller disturbances or stresses over a number of years. In the latter case, oil-development impacts described above may well be a contributor, adding to the critical mass of changes.

For example, if an oil spill reached Shelikof Strait it could impact the major concentration of pollock reproduction and early growth for the entire Gulf of Alaska. The smaller eddies that form in certain environmental conditions normally promote higher survival and growth of pollock larvae. However, they could also concentrate and retain spilled oil thereby severely lessening impacting pollock survival. The cumulative stresses could have more far-reaching and long-lasting effects on the balance within the ecosystem. Individual small effects could add to stresses already present to alter balances between species that could suddenly shift the system into another very different and unpredicted ecological regime.

Habitat Areas of Particular Concern. Living substrates in shallow and deep waters (corals, sponges, mussels, rockweed, and kelp) and freshwater habitats used by anadromous fish were identified by the North Pacific Fishery Management Council as Habitat Areas of Particular Concern (www:afsc.noaa.gov/groundfish/HAPC/HAPC.htm).

Heifetz (2000) reviewed coral distributions in Alaska. Corals in the lease sale area are mostly gorgonian and cup corals; the associated commercial fish species are primarily rockfish, Atka mackerel, gadoids (cod), and flatfish (halibut and sole).

Cook Inlet, Shelikof Strait, and Kennedy Entrance have few notable regions of eelgrass and kelp except within Kachemak Bay (Otis and Gretsch, 2002, pers. commun.). Pacific salmon and eulachon are common anadromous fish with freshwater habitat in Cook Inlet.

Waterways used by anadromous fishes and living substrates in estuarine, subtidal, and intertidal areas may experience adverse impacts resulting from small, frequent oil spills and/ or one or more large oil spills. Effects are discussed above and in Section IV.B.1.d(3)(b) (Fisheries Resources). Impacts may destroy living substrates in shallow and intertidal waters if contacted by moderate to heavy concentrations of oil and subsequently affect proximate community assemblages and structure. Such impacts may take decades for habitats and communities to recover to their pre-oil spill status, although proximate community organization may never be achieved. Recolonization and recovery of impacted habitat areas of concern in estuarine and intertidal waters will depend in part on the magnitude of spill contact, the proximity of source populations, transport vectors and barriers, and amounts of oil entrapped in habitat sediments. Recolonization and recovery can be delayed for months and years depending on a suite of variables.

IV.B.1.e(5) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

Impacts of Sale 199 would likely be the same as for Sale 191 except timing would be about 2 years later.

IV.B.1.e(6) Effectiveness of Mitigating Measures

Standard Stipulations and Notices to Lessees, which are listed in Section II.F, are considered mitigation measures. Stipulation No. 1 - Protection of Fisheries relates to conflicts with the fishing community and their gear. It does not relate directly to fish or essential fish habitat.

Stipulation No. 2 could most directly relate to essential fish habitat mitigation. Stipulation No. 2 - Protection of Biological Resources applies to biological populations or habitats that are identified by the Regional Supervisor, Field Operations, MMS. The Field Operations Regional Supervisor may require biological surveys and, based on the surveys or other information available, require relocation, modification, or time restrictions of operations. Lessees are required to report any area of biological significance they discover and submit all data obtained in the course of biological surveys.

There are no reports indicating that any biological surveys, relocations, or modifications have resulted from Stipulation No. 2 in previous sales.

Oil-spill related ITL clauses notify lessees of legal requirements enforced by other agencies. The ITL clauses to be incorporated in the lease include ITL's No. 3 and No. 5. ITL No. 3 - Sensitive Areas in Oil-Spill-Response Plans identifies specific areas to be considered in oil-spill-response planning. Kamishak Bay has high value for essential fish habitat and is specifically identified for consideration in oil-spill-response planning. The ITL No. 3 also requires prior approval before dispersants are used. ITL No. 5 - Information on Oil-Spill-Response Preparedness advises lessees that they must be prepared to respond to oil spills.

The ITL's No. 4 and No. 6 reaffirm regulations of other Federal and State of Alaska agencies related to water quality. ITL No. 4 - Information on Coastal Zone Management refers to regulations of the State of Alaska, Division of Governmental Coordination whereby state agencies and coastal districts adjacent to the activity review these plans for consistency with their Coastal Management Programs. The ITL No. 6 -

Drilling Fluids and Cuttings Discharge during Post-Lease Activities refers to National Pollution Discharge Elimination System permits issued by the Environmental Protection Agency.

IV.B.1.f. Effects of Sale 191 on Endangered and Threatened Species

As detailed in Section III.B.4, endangered and threatened species and species that are candidates for listing, recently delisted, or are likely to be listed under the ESA, occur in areas within or near the Cook Inlet program area. Thus, there could be effects on these species from OCS oil and gas exploration, development or production that could ultimately result from the proposed sale.

As noted elsewhere in this document, but repeated here to ensure clarity, Section 7(a)(2) of the ESA of 1973, as amended, states:

> Each federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded or carried out by such agency is not likely to jeopardize the continued existence of any endangered species and threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical, unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this chapter.

Over the past 20 years, the MMS, Alaska OCS Region has consulted with the Fish and Wildlife Service and the National Marine Fisheries Service on previous lease sales in this region. The most recent of these consultations concerned the potential impacts of Cook Inlet Sale 149. In their 1993 Cook Inlet Sale 149 biological opinion, the National Marine Fisheries Service concluded that lease sale and associated activities would not be likely to jeopardize the continued existence of Steller sea lions, gray whales, humpback whales, right whales, fin whales, sei whales, sperm whales, blue whales, and four separate stocks of Pacific salmon or to result in the destruction or adverse modification of critical habitat for the Steller sea lion. In their 1995 Cook Inlet Sale 149 biological opinion, the Fish and Wildlife Service concluded that leasing and exploration activities would not be likely to jeopardize the continued existence of short-tailed albatross, arctic and American peregrine falcons, or Aleutian Canada geese.

Consultation with the National Marine Fisheries Service and the Fish and Wildlife Service also occurred related to proposed Sale 88 in the Gulf of Alaska/Cook Inlet in 1984. In the Sale 88 biological opinion, which evaluated the impacts of proposed OCS activities in the eastern Gulf of Alaska, Cook Inlet, and Shelikof Strait, the National Marine Fisheries Service concluded that:

> ….any additional impacts from OCS activities that affect the well-being of individual North Pacific right whales would be likely to jeopardize the continued existence of this species; and (2) cumulative impacts to gray whales may result from the combination of OCS activities along the migratory route of this species, however, more information is needed before a reliable opinion can be rendered on such impacts.
>
> The National Marine Fisheries Service believes that the Department of the Interior (USDOI) can plan activities associated with oil and gas leasing and exploration in the Gulf of Alaska/Cook Inlet area to avoid impacts to the North Pacific right whale and thereby avoid jeopardizing the continued existence of this species.

The National Marine Fisheries Service biological opinion for Sale 88 contained reasonable and prudent alternatives that the Department of the Interior could adopt to meet this goal. With respect to this jeopardy finding and the Cook Inlet/Shelikof Strait region, it stated: "Right whales are not known to occur within Cook Inlet/Shelikof Strait; therefore, activities in this area are not of major concern."

In their biological opinion on the 1980 Lower Cook Inlet-Shelikof Strait Sale 60 (which, while larger, included the program area of the Cook Inlet multiple-sales Proposal), the National Marine Fisheries Service concluded that the lease sale and exploration activity associated with Sales 46, 55, and 60 are not likely to jeopardize the continued existences of any endangered whale or its habitat.

In the 1984 Sale 88 biological opinion, the Fish and Wildlife Service concluded that leasing and exploration activities would not be likely to jeopardize the continued existence of short-tailed albatross, arctic and American peregrine falcons, or Aleutian Canada geese.

As required under the ESA and its implementing regulations, the MMS notified the National Marine Fisheries Service and the Fish and Wildlife Service by letters dated June 18, 2002, of those endangered, threatened, and candidate species of which it was aware that could occur in areas within or near the Cook Inlet program area and that could, therefore, potentially be affected by the Proposed Action. The MMS asked the National Marine Fisheries Service and the Fish and Wildlife Service either to concur with the list or to identify needed additions or deletions. The National Marine Fisheries Service responded by letter dated June 23, 2002, confirming the following species under its jurisdiction as those that should be included in our evaluation of impacts on ESA species: beluga whale (Cook Inlet stock), blue whale, humpback whale, North Pacific right whale, sei whale, sperm whale, and the Steller sea lion (western and eastern stocks). The Fish and Wildlife Service responded by letter dated July 8, 2002, confirming the following species under their jurisdiction as those that should be included in our evaluation: Aleutian Canada goose (delisted 2001), Steller's eider (Alaska breeding population - threatened), American peregrine falcon (delisted 1999), northern sea otter (west of Unimak Pass - candidate), and the short-tailed albatross (endangered). In the June 18, 2002, letter to the Fish and Wildlife Service, the MMS also indicated that we intended to undertake thorough analyses of the potential impacts of the Proposed Action on Kittlitz's murrelets, because we understood from previous discussion with the Fish and Wildlife Service that it was likely that this species was going to be designated a candidate species under the ESA within the next few months. Based on the overall concurrence of the Fish and Wildlife Service with the species list letter, we undertook analyses of potential effects of the Proposed Action on that species. However, at the time of finalization of the draft EIS, Kittlitz's murrelets had not been designated as a candidate species. Thus, we have placed our baseline information and analysis of potential effects on Kittlitz's murrelets in Appendix G.

Additionally, despite the concurrence on July 8, 2002, of the Fish and Wildlife Service with the information in our species-list letter, the candidate designation for sea otters already had been revised on June 13, 2002 (67 *FR* 40657), to include sea otters that reside along the north and south sides of the Alaska Peninsula, all areas of the Aleutian Islands, and in the Kodiak Archipelago, in addition to those sea otters west of Unimak pass that already were designated as candidates. Thus, we modified our analyses to reflect the area encompassed by the revision.

The draft EIS was completed and, in accordance with Section 7(a) of the ESA, the MMS initiated formal consultation on the proposed Cook Inlet multiple-sales program with both the Fish and Wildlife Service and the National Marine Fisheries Service by letter in November 2003. At the time of initiation of formal consultation, the draft EIS was submitted to the Fish and Wildlife Service and the National Marine Fisheries Service to provide them with information about the Proposed Action and our evaluation of the potential for adverse effects on threatened and endangered species. This information, in addition to other information available to these agencies, enabled these two agencies to formulate biological opinions regarding whether the Proposed Action is likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat of such species, which is determined by the Secretary, after consultation as appropriate with affected States, to be critical. Both of these consultations were concluded in March 2003. Appendix C contains copies of the consultation communications and a brief outline of key benchmarks in the consultations.

The analyses in this section are based on the exploration and development scenarios presented in Section II.A, Section II.B, and Appendix B of this EIS. We refer the reader to those sections for detailed discussion of likely exploration scenarios, timing of infrastructure development, assumed resource-recovery rates and quantities, assumed pipeline placement, resource production timeframes, and other information relevant to the development of resources that would occur under the Proposed Action (Alternative I) for Sales 191 and 199.

IV.B.1.f(1) Conclusion

It is unlikely that adverse effects to threatened and endangered species from routine and common activities of exploration, development or production will exceed the significance thresholds (as defined in Section

IV.A.1). Effects to individuals (for example, displacement due to noise or other disturbance, collisions with structures, etc.) and effects that are relatively localized (for example, due to pipeline placement or due to small oil spills) and short-term impact could occur due to such activities. Because they currently are in serious decline, displacement of western population Steller sea lions from important critical habitats, such as important feeding areas, potentially could result in a significant effect on the population if alternative, equally valuable food areas were unavailable to them or their shift to alternative areas displaced other Steller sea lions. A significant effect on the western population of Steller sea lions also could occur, if such sea lions were disturbed and potentially killed as a result of aircraft (primarily helicopter) disturbance near important rookeries or haulouts. This type of disturbance should be avoided by compliance with National Marine Fisheries Service-specified flight practices that ensure that such noise does not affect sea lions on these terrestrial critical habitats. In the event of a large oil spill, sea otters from the southwest Alaska stock and western population of Steller sea lions could suffer significant effects. However, while the vulnerability of sea otters to oil spills is clear, the level of vulnerability of Steller sea lions is less certain. It is unlikely that there would be significant population-level adverse effects on the eastern population of the Steller sea lions.

Steller's eiders could be adversely affected by a spill during the late autumn, winter, or early spring. Fin whales are vulnerable to a large spill that entered Shelikof Strait at any time of the year, whereas humpbacks primarily are vulnerable only during the late spring, summer, and autumn months but are unlikely to be affected during the winter or early spring. Beluga whales could be adversely impacted by a large spill in the nonsummer months. The likelihood of oil-spill effects on cetaceans, even in the event of a large spill, is uncertain. There are no data available to the MMS that definitely link a large oil spill with a significant population-level effect on a species of large cetacean. Based on available information, potential effects on fin whales or humpback whales from even a large spill are likely to be local and not have population-level effects. However, National Marine Fisheries Service biologists have observed hundreds of humpbacks near the Barren Islands in late May. If a large spill occurred in the Barren Islands area when such large numbers of humpbacks are present and feeding, we cannot rule out the possibility that there could be a population-level effect on this species. Available information suggests that a large spill originating in other areas of the proposed multiple-sale area, but outside of the Barren Islands area, would not have the potential to have a population-level effect on this species. With respect to potential oil-spill effects, the National Marine Fisheries Service (2003) concluded that:

> *Most sea lions and whales exposed to spilled oil are expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey items, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals may be killed as a result of exposure to freshly spilled oil…the percentage of the stock or population of these animals so affected is expected to be small.*

A significant effect to the Alaska breeding population of Steller's eiders following a large spill is unlikely, primarily because most of the affected eiders would be expected to be from the Russian breeding populations. However, uncertainties about the accuracy of this assumption make estimation of potential effects difficult. Individual American peregrine falcons potentially could suffer some adverse effect from disturbance associated with the Proposed Action, or, in the event of a large oil spill, by catching and eating oiled prey. Such effects are unlikely due to their distribution and relative rarity in the area. Potential adverse effects of any kind are not likely for blue whales, North Pacific right whales, sperm whales, Aleutian Canada geese, and short-tailed albatross.

IV.B.1.f(2) Summary of Potential Effects

Routine activities of proposed OCS oil and gas exploration, development, and production in Cook Inlet are not likely to have any discernible effects on blue whales, sperm whales, North Pacific right whales, short-tailed albatrosses, and American peregrine falcons primarily because these species do not typically occur within, near, or "downstream" of the proposed Cook Inlet lease-sale area.

A small number of sei whales have been observed in areas where they potentially could be adversely affected by activities associated with the proposed sale, but their occurrence in such areas is rare. For this reason, no adverse effects on even individual sei whales are likely. However, there is a small possibility that an individual sei whale potentially could be impacted in the event that a large oil spill occurred and entered Shelikof Strait during the summer. It also is unlikely that even individual Aleutian Canada geese would be affected by the Proposed Action, because the Proposed Action area is outside their nesting and typical migration range. Oil-spill analyses indicate that it is highly unlikely that oil spilled in Cook Inlet would contact the nearest breeding islands in the Semidi Islands, and this subspecies is not known to rest on saltwater during migration.

In specific areas, particularly near the Barren Islands and Cape Douglas, the behavior of Steller sea lions from both populations, but particularly from the western population, in the water potentially could be modified by noise and other disturbance from seismic surveys and the placement of drilling rigs during exploration and development. Aircraft, particularly helicopter disturbance, potentially could disturb sea lions on rookeries and haulouts in the Barren Islands and Cape Douglas and even cause mortality, if stampeding occurred. These effects could probably be avoided through flight practices aimed at avoiding such effects, particularly for helicopters in regions near these terrestrial habitats. However, most potential effects on Steller sea lions are related to activities that would occur during production. A large oil spill during production could harm (for example, cause lung or other organ damage) or even kill adults, juveniles, or pups that inhale high concentrations of vapors from fresh oil, especially if they are already in a weakened physiological state. Skin irritation and eye damage could result from prolonged surface contact with oil. Such conditions can increase an individual's physiological stress and increase the likelihood of death of individuals that are highly contaminated or already weakened. Because they rely on their hair for thermal protection, sea lion pups are more vulnerable than are adults to oiling and could die if significantly oiled. Thus, a spill during peak pupping season could cause pup mortality, if pups were oiled through contact with the beach or from their mothers. However, available data do not indicate such effects have typically occurred after previous spills or, if they have, that large numbers of individuals were affected. The experience after the *Exxon Valdez* oil spill was that oil did not remain on haulouts or tend to remain on adults. However, no rookeries were in the path of fresh oil from the *Exxon Valdez* oil spill. Adults do not appear to be extremely susceptible to oil spills. However, long-term impacts on health, survival, or reproduction have not been well studied. The ongoing decline in Steller sea lions made it difficult to sort out potential population-level impacts of the *Exxon Valdez* oil spill. The National Marine Fisheries Service (1993) previously concluded that oil and other contaminants released into the aquatic environment could adversely affect the health, survival, and reproductive ability of Steller sea lions. A large spill could have adverse effects on individuals from both populations, but it is unlikely that such a spill could have a significant population-level effect on the eastern population.

The pelagic waters of Shelikof Strait, an aquatic foraging area component of Steller sea lion critical habitat, could be contacted by an oil spill originating in the program area in Cook Inlet. However, the combined probabilities of a large spill actually occurring and contacting this or other Steller sea lion critical habitats are relatively low. The National Marine Fisheries Service (1995) concluded that any impact of an oil spill or other oil- and gas-related activity that had an adverse effect on the production or availability of forage fish within sea lion critical habitats would have adverse impacts on this critical habitat.

The behavior of individuals from the Southwest Alaska stock of sea otters could be modified by noise and disturbance associated with exploration and development. The most likely impacts could be the disturbance of sea otters that are hauled out, and the displacement of females and pups that occur near regions of focused activity. If they occurred at all, these effects are expected to be local and have no population-level impacts on the widely distributed Southwest Alaska sea otter stock. In comments on a draft of the EIS, the Fish and Wildlife Service provided the following information to the MMS: "Our GIS analysis suggests that the geographic overlap between the proposed lease sale area and sea otters from the southwest Alaska" Distinct Population Segment "is minimal." Sea otters from the Southwest Alaska stock in Kamishak Bay, the northwestern tip of the Kodiak Archipelago and Shuyak Island, Shelikof Strait, and portions of the southern shoreline of the Alaska Peninsula could be killed if contaminated by oil from a large spill (for example, one of 4,600 barrels). Estimates of total expected mortality could vary widely, depending on which areas were contacted and where sea otters were at the time oil came through. In 2002, the Fish and Wildlife Service estimated that 6,918 sea otters (about 16.7% of the total estimate of the southwest Alaska stock) currently occupy Kamishak Bay, with 5,212 (approximately 12.6%) currently occupying the south shore of the Alaska Peninsula between Cape Douglas and Seal Cape, and about 5,893 (approximately 14.2%) occupying the Kodiak Archipelago. No recent offshore data are available for sea otter abundance in the Shelikof Strait region. Depending on exactly which areas were oiled and where sea otters were distributed at the time of a spill, a large oil spill could affect local distribution and abundance and potentially have chronic impacts in affected areas in Cook Inlet, the south shore of the Alaska Peninsula, and the Kodiak Archipelago. In the event that a large oil spill did occur and contact large numbers of sea otters, data available after the *Exxon Valdez* oil spill indicate that there potentially could be a significant effect on the designated southwest Alaska stock of sea otters, and that recovery time could exceed a generation. However, the combined probabilities of a large oil spill actually occurring in areas where there could be large numbers of sea otters are relatively low. Despite the well-documented vulnerability of sea otters to oil pollution, large-scale mortality was not documented after the *Glacier Bay* oil spill in Cook Inlet.

The behavior of feeding humpback whales and, less likely, fin whales, in the areas near the Barren Islands and Kennedy and Stevenson entrances could be adversely affected by noise from seismic exploration in leasing blocks in these areas. If they occurred, these effects would be localized and relatively short-term. Fin whales are vulnerable to the impacts of a large oil spill that enters Shelikof Strait at all seasons of the year. Humpback whales could be adversely affected by oil spilled near the Barren Islands, in Kennedy or Stevenson entrances, the southern portions of lower Cook Inlet, or the waters between Cook Inlet and Shelikof Strait, and by oil that entered (from one of the aforementioned regions) Kachemak Bay or especially Shelikof Strait during the late spring, summer, and autumn. There are no data available to the MMS that definitely link a large oil spill with a significant population-level effect on a species of large cetacean. Based on available information, potential effects on fin whales or humpback whales from even a large spill are likely to be local and not have population-level effects. However, the National Marine Fisheries Service biologists have observed hundreds of humpbacks near the Barren Islands in late May. If a large spill occurred in the Barren Islands area when such large numbers of humpback are present and feeding, we cannot rule out the possibility that there could be a population-level effect on this species. Available information suggests that a large spill originating in other areas of the proposed sale area, but outside of the Barren Islands area, would not have the potential to have a population-level effect on this species. In their Biological Opinion, the National Marine Fisheries Service(2003) concluded that:

> Most sea lions and whales exposed to spilled oil are expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey items, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals may be killed as a result of exposure to freshly spilled oil…. The percentage of the stock or population of these animals so affected is expected to be small."

Ingestion, surface contact with, and especially inhalation of fresh crude oil has been shown to cause serious damage and even death in many species of mammals. However, postspill studies on cetaceans, specifically, are inadequate to confidently estimate the likelihood that serious injury to individuals of either of these two species would occur with oil exposure. Small spills are unlikely to have serious adverse effects on threatened or endangered cetaceans. We do not expect large oil spills during exploration.

Local effects on the behavior, movement patterns, or habitat use of Cook Inlet belugas could occur because of disturbance from support vessels, drilling, seismic exploration, and other disturbance associated with oil and gas exploration and development. These belugas also could be impacted by a large oil spill, particularly if such a spill occurred in the nonsummer months when belugas are more likely to be in the lower Cook Inlet area. As mentioned regarding humpback and fin whales, the general literature suggests that mammals can suffer serious harm from exposure to fresh oil. However, no evidence exists that ongoing oil and gas development in Cook Inlet has had adverse effects on beluga whales, or that they suffered any harm from previous small or large spills in Cook Inlet.

In the event that a large spill (greater than 1,000 barrels) occurred during the winter, local mortality of wintering Steller's eiders could occur, particularly in eastern and western Cook Inlet, outer Kachemak Bay and, less likely, in the Kodiak Archipelago. Smaller spills also could cause mortality of a relatively few number of individuals. However, it is difficult to estimate numbers of this species that could be lost in the event of a large spill due to between-year, seasonal, and potentially even weekly changes in the distributions of the birds, uncertainties about where oil may be spilled, and uncertainties in the population identity of Steller's eiders that overwinter in the region. Based on assumptions made by the Fish and Wildlife Service, the vast majority of the affected individuals likely would be from the Russian breeding population rather than the ESA-listed Alaska breeding population. Habitat alteration resulting from pipeline construction could cause loss of feeding habitat in shallow, nearshore areas between Anchor Point and Clam Gulch. This loss possibly could be avoided by careful site placement of such a pipeline. Some minor and short-term disturbance of these birds is possible due to overflying aircraft and vessel transit. It is possible that Steller's eiders could be killed or injured due to collisions with lighted platforms. Because these platforms would be offshore, the risk of this type of mortality probably is highest during migration and during foggy weather.

Noise and disturbance associated with pipeline construction and vessel transit to platforms could have temporary, localized impacts on the behavior of wintering eiders, resident sea otters, and beluga whales during the winter.

IV.B.1.f(3) Effects of Exploration on Threatened and Endangered Species

IV.B.1.f(3)(a) Potential Pathways of Impact

There are multiple potential pathways through which species that are designated as endangered, threatened, or candidate species under the ESA could be impacted by exploration actions that could result from the proposed OCS Cook Inlet oil and gas lease sales in 2004 and 2006. Noise, potential disturbance, and discharges associated with drilling all could be expected to result from routine OCS oil and gas exploration activities. Additionally, endangered or threatened species conceivably could collide with drilling structures or be struck by support vessels. Any or all of these factors potentially could adversely affect ESA-protected species in or near the proposed sale area.

In Section IV.B.1.f(3)(b), we provide background information on factors resulting from OCS oil and gas exploration and development that could affect ESA-protected (or other) species. Based on that information and information from studies about the potential impacts of each factor on specific species and on similar species, we evaluate the potential for various ESA species to be affected by that factor.

IV.B.1.f(3)(b) Noise and Disturbance Associated with Exploration

During OCS oil and gas exploration, development, and production activities, human-caused noise is transmitted through the air and through marine waters from a variety of sources including, but not limited to, seismic-survey operations, ship and boat transit, helicopters, pipeline and platform construction, platform abandonment, and drilling. In Cook Inlet, these sounds are propagated during OCS oil and gas activities into an environment that already has numerous sources of human-caused sound, such as that from fishing and tour boats, tankers, barges, airplanes and helicopters, human settlements, and marine development (such as harbor construction). In this section, we describe sounds and disturbances that likely would result from exploration.

To evaluate the impacts of noise resulting from the Proposed Action, an understanding of the types of noise produced is necessary. Properties of the sound that influence how far that sound is transmitted, what species hear it, and what physical and behavioral effects it can have include its intensity, frequency, amplitude, wavelength, and duration in addition to the distance between the sound source and the animal, whether the sound source is moving or stationary, the level and type of background noise, and the auditory and behavioral sensitivity of the species (Richardson et al., 1995). The frequency of the sound is usually measured in hertz, pressure level in micropascals (Gausland, 1998), and intensity levels in decibels (Richardson et al., 1995; McCauley et al., 2000). McCauley et al. (2000) and others (see references in McCauley et al., 2000) express this in terms of its equivalent energy decibels re 1 microPascal root mean square? (decibels re 1 μPa^2.). The perceived loudness of any given sound is influenced by many factors including both the frequency and pressure of the sound (Gausland, 1998), the hearing ability of the listener, the level of background noise, and the physical environment through which the sound traveled before reaching the animal.

Richardson et al. (1995), Gausland (1998), and Ketten (1998) provide clear summaries of background information relevant to evaluating impacts of noise on marine mammals or any marine organism. Based on summaries in these documents, and other references as noted, the following information about sound transmission is relevant to evaluating the potential impacts of sound on marine mammals:

- First, sound travels faster and with less attenuation in water than it does in air.

- Second, the fate of sound in water can vary greatly, depending on characteristics of the environment through which it travels (Richardson et al., 1995; McCauley et al., 2000). Extrapolation about the likely impacts of a given type of sound source in Cook Inlet on a particular marine mammal, based on published studies conducted elsewhere, are somewhat speculative because characteristics of the marine environment such as bathymetry, sound-source depth, and seabed properties greatly impact the propagation of sound horizontally from the source (McCauley et al., 2000; see also Chapter 4 in Richardson et al., 1995 and references provided therein). Richardson et al. (1995:425) summarized that: "…a site-specific model of sound propagation is needed to predict received sound levels in relation to distance from a noise source."
- Third, sound propagation also can vary seasonally in the same environment.
- Fourth, because the air-water interface acts as a good reflector, sound generated underwater generally will not pass to the air (Gausland, 1998).

IV.B.1.f(3)(b)1) Noise from Seismic Surveys

One source of noise associated with oil and gas exploration is the airgun. At the source, these produce underwater sound levels exceeding those of other activities discussed in Sections IV.B1.f(3)(b)1).

High-energy noise sources operated in the water column are used in offshore seismic surveys to provide geophysicists with profiles of the geologic structures below the seafloor. This type of survey provides oil and gas producers information about likely reservoirs of petroleum. It also is used sometimes in producing oil fields to monitor the flow of hydrocarbons (McCauley et al., 2000), although it likely would not be used in Cook Inlet for this purpose. Typically, seismic sources used in such surveys involve the rapid release of compressed air to produce a high-energy, impulsive signal that is directed downward through the seabed. Thus, the source for the sound is called an "airgun." However, sound from the airgun also is propagated horizontally, with the distance traveled depending on many factors, such as those discussed by Richardson et al. (1995) and McCauley et al. (2000). Richardson et al. (1995:290-291) summarized: "Underwater sound pulses from airgun arrays and similar sources are often audible many tens of kilometers away." The Joint Nature Conservation Committee of the United Kingdom (Appendix 1 in Stone, 2001) reported that in modern, large-scale seismic surveys, the airgun array is fired at intervals of about 10 seconds, with timing depending on the exact objects of the survey.

During three-dimensional seismic surveys in Cook Inlet, a single airgun array likely would be towed behind the seismic vessel (probably about a 250- to 300-foot vessel), with the airguns at a depth of about 30-45 feet. Unlike seismic surveys that are typically undertaken in the Beaufort Sea, there would be nothing (no ocean bottom cables) on the ocean floor. It is expected that the interval of timing of airgun firing in Cook Inlet would be greater than or equal to 6 seconds and more typically about 12 seconds. Both high-energy seismic exploration and high-frequency (also called high-resolution) seismic surveys could be undertaken in Cook Inlet following lease sales. However, in Alaska, high-energy seismic surveys during which large areas are surveyed to obtain profiles of oil and gas structures often are undertaken prelease. However, high-energy seismic surveys can be undertaken after lease sales or between one lease sale and the next. High-frequency or high-resolution seismic profiling usually is undertaken for engineering purposes and could be undertaken postlease to determine the suitability of locations for emplacement of drilling rigs. The energy level in these types of surveys is much lower than that used in the high-energy seismic surveys; thus, the radius of noise exposure is many times smaller.

Noise from seismic surveys is not stationary and is not a single event. The duration of exploration can continue for varied lengths of time, and the area covered depends on the interests and needs of the explorer. McCauley et al. (2000:695) stated: "Seismic vessels steam at around 3-5 knots…along straight tracklines in the region of the survey for weeks to months operating at an 8-15 s [second] repetition rate…. A 3D seismic survey may concentrate activity in a few hundred square kilometers for upward of a month, with a trackline coverage every 100 meters." Trackline coverage can vary, however. Transient noise from such a survey has been recorded on land seismometer arrays 6,100 kilometers away after traveling the deep sound channel (Okal and Talandier, 1986). However, McDonald, Hildebrand, and Webb (1995) suggest that these same sounds may not have been detectable by a whale near the surface in the mid-Pacific because of entrapment in the deep sound channel.

Seismic airguns are meant to produce low-frequency noise, generally below 200 Hertz. However, the impulsive nature of the collapse of the air bubbles inevitably results in broadband sound characteristics. Recently, Goold (1996, cited in Stone, 2001) reported that high-frequency noise is also produced. Goold (1996a) also found significant levels of energy from airguns across the bandwidth up to 22 kilohertz. McCauley et al. (2000) concluded that the most consistent measure of a received airgun signal was a measure of its energy, as was suggested by Richardson et al. (1995) for pulsed sounds.

McCauley et al. (2000) stated that a precise definition of the seabed to at least 50-100 meters is required to accurately predict horizontal propagation along a travel path. Based on experimental measurement of signals from a single airgun, McCauley et al. (2000) found signal differences of airgun broadband levels of up to 10 decibels at a 1-kilometer range. They concluded that such large differences in levels, measured for the same source at a given range within the same bay, demonstrated the importance of localized properties of seabeds in determining sound propagation. Other factors that also can significantly affect sound propagation include the orientation of the receivers (the orientation of living animals could similarly affect reception), alignments and depths of array components and of functioning guns within the array, and airgun source depth. The depth at which the firing airgun is placed plays a crucial role in the potential for propagation. Increasing source depth consistently increased the received signal at any specified receiver depth (for example, the depth of the animal) and horizontal range. Upslope propagation, where the receiver is much shallower than the deeper placed sound source but is on the bottom, results in larger signal attenuation compared to propagation over similar distances but at a constant water depth. Thus, if the animal is in a shallow-water area and on the bottom, and the airgun is in much deeper water and downslope from the animal, attenuation will greatly affect the sound the animal will receive.

Based on all of the aforementioned, McCauley et al. (2000) concluded that predicting sound propagation from any specified airgun array needs to be done on a case-by-case basis.

Bain (2002) found that approximately one-third of sound levels measured during seismic surveys varied by 6 decibels from expected values. Shadow zones caused sound levels lower than expected, and land was an effective barrier to direct sound propagation. Cases of levels higher than expected probably were due to upslope enhancement of sound. Long-range propagation through the Strait of Juan de Fuca was better than expected, resulting in airgun noise being clearly audible at ranges of 60-70 kilometers. This was the longest distance at which signal measurement was attempted, and it is possible that the sound was audible at even greater distances. Bain (2002) reports that high frequencies attenuated faster with distance (this would decrease impacts to beluga whales), and low frequencies were filtered out by propagation through shallow water.

Because high-energy and impulsive sounds can cause hearing damage, there is considerable concern about the potential impacts of airguns on marine organisms. Sound from seismic surveys potentially could have negative impacts on marine mammals within or near the program area. Because of the distance sound can travel through water (see the following), marine mammals in regions of the Gulf of Alaska that are near to the areas of survey, or that are connected to the area of exploration by a relatively unimpeded sound travel path, also could be affected by the sound.

The low-frequency noise (generally below 200 Hertz) produced by seismic airguns are more likely to disturb baleen whales, which communicate at frequencies mostly below 3 kilohertz. Thus, their communications are more likely to overlap with those low frequencies than are the communications of beluga whales. However, because of the high-frequency noise that also is produced, marine mammals that are sensitive to high frequencies also can be affected. The hearing of beluga whales extends at least as low as 40-75 Hertz, but their sensitivity at this level probably is poor. The hearing range of at least some individual belugas extends up to 80-150 kilohertz (Richardson et al., 1995 and references cited therein). However, Richardson et al. (1995) caution that the estimated hearing thresholds for many species may be inaccurate and possibly too high at frequencies between 1 and 10 kilohertz.

High-energy seismic surveys in Cook Inlet likely would be feasible only between May and mid-September. Thus, species that only overwinter in the region, or that are unlikely to be present during these months (for example, Steller's eiders), are unlikely to be exposed to this noise source.

V.B.1.f (3)(b)2) Noise from Drilling

Drilling for oil and gas generally produces low-frequency sounds with strong tonal components. There are few data on the noise from conventional drilling platforms. Recorded noise from an early study of one drilling platform and three combined drilling production platforms found that noise was so weak, it was almost not detectable alongside the platform at sea states of 3 or above. The strongest tones were at very low frequencies near 5 Hertz, and received levels of these tones at near-field locations were 119-127 decibels re 1 micropascal (Richardson et al., 1995).

IV.B.1.f(3)(b)3) Other Sources of Noise and Disturbance

During exploration, noise also is produced by supply vessels and low-flying aircraft, construction work, and dredging. Airborne sounds from aircraft and from high-speed motorboats are especially relevant to Steller sea lions and, probably to a lesser extent, sea otters, because both species haul out. Such noises also have the potential to disturb birds. The transmission of aircraft sound to cetaceans or other marine mammals while they are in the water is influenced by the animal's depth, the altitude, aspect, and strength of the noise coming from the aircraft in addition to bottom characteristics and other factors. Generally, the greater the altitude of the aircraft, the lower the sound level received underwater. Dominant tones from helicopters, which are especially relevant to Steller sea lions, are generally below 500 Hertz (Richardson et al., 1995). Ships produce noise from sounds coming from engines, vibrating and rattling structural components and, primarily, from cavitation of the propeller. Richardson et al. (1995) reported that the noise generated by a large container vessel, bulk carrier, or supertanker can exceed 190 decibels up to 205 decibels in the lowest frequencies. Tugboats and ferries produce noise up to 150-170 decibels at the source.

The oil and gas that ultimately could be produced from the proposed lease sale are expected to be used for local consumption. Therefore, no additional tankering noise is predicted.

In the proposed Cook Inlet exploration and development scenario, an average of one to two helicopter flights per day is expected to originate from the Kenai/Nikiski area. Our analyses of potential effects presume that oil-industry personnel and related contractors would comply with all ITL clauses on Bird and Marine Mammal Protection. Thus we presume they would avoid flying within 1 mile of known bird or marine mammal concentration areas (when weather conditions permit), such as those identified here for wintering Steller's eiders. Such compliance would prevent frequent or excessive disturbance of these feeding flocks. However, occasional helicopter disturbance still could occur, especially if exploration activities result in helicopter transit from Nikiski or the Kenai Peninsula (south along the coast) to points such as the Anchor Point region or across the bay to the area just off Point Bede.

Other potential sources of noise, disturbance, and possible injury to threatened and endangered species during OCS oil and gas exploration are activities associated with abandonment of delineation wells. The casings for delineation wells can be cut mechanically or with explosives during the process of well abandonment. The use of explosives could result in injury or even death to threatened and endangered marine mammals or birds that are in the area at the time of the explosions. Underwater blasts can kill or injure marine mammals that are nearby, although the threshold levels for injury or death are not well established (for example, Ketten, Lien and Todd, 1993; Richardson et al., 1995). With respect to the abandonment of delineation well abandonment, the MMS (USDOI, MMS, Pacific OCS Region,? 2001) previously summarized that

> …the use of explosives for delineation well abandonment would involve the detonation of a relatively small, 16- to 20-kilogram charge in the well casing 5 meters below the sea floor. This positioning of the charge would dampen the explosion and restrict shock and acoustic effects primarily to the area of water immediately above the well head. However, a marine mammal close to the detonation site potentially could be injured or killed, or suffer permanent or temporary hearing damage. Some disturbance of marine mammals present in the vicinity of the detonation area could also occur, but these would be expected to be minor and temporary…Overall, impacts from this source are expected to be low.

Threatened and endangered, or candidate species that regularly occur in areas where such well-abandonment activities potentially could take place include Steller sea lions, beluga whales, sea otters, humpback whales and, to a lesser extent, Steller's eiders (because they are less likely to be offshore) and fin whales. However, recent data forwarded to the MMS by the Fish and Wildlife Service indicate that it is unlikely that sea otters from the designated southwest Alaska population stock are likely to occur within the proposed multiple-sale area. Thus, adverse effects from such activities are unlikely. Impacts to threatened and endangered species from well-abandonment activities probably could be minimized or avoided if sufficient monitoring for such species occurred prior to the use of any explosives, and protocols were implemented to ensure that such explosives were not used if such species were in areas where there was a potential for them to be adversely impacted by the explosives. While impacts to several species from well-abandonment activities could be avoided almost entirely by undertaking these activities only when these species are absent, there is no season when all of the species would be absent. Some threatened and endangered species, such as Steller's eiders, overwinter in the region; some, such as humpback whales, tend to be present in nonwinter months; whereas others, such as sea otters and sea lions, are present year-round.

IV.B.1.f(3)(b)4) Potential General Impacts of OCS Oil- and Gas-Related Noise and Disturbance

In this section, we provide background about potential effects of impacts of OCS oil- and gas-related noise and disturbance. This section should not be interpreted as indicating effects that are likely to occur due to the Proposed Action on any specific species, or group of species. Hearing (auditory) systems and perception are species specific and habitat dependent. As noted repeatedly in this section, the fate of sound after it is produced is also habitat, and even potentially season and weather specific. Because of these fundamental facts, the potential for a given sound to cause adverse effects to an animal also is species specific and habitat dependent. Because of differences in bathymetry and seabed characteristics of sites throughout the Cook Inlet program area, the distances that sounds of various frequencies, intensities, and pressures will propagate, and the resulting effects such sounds could have, also are expected to differ greatly among specific sites (for example, among specific leasing blocks that differ in seabed properties, bathymetry, and the amount of wave action). Thus, the exact location of any seismic exploration will determine the fate of sound released at that site and, therefore, will affect the possibility of impact on threatened and endangered species in or near the area.

Available evidence also indicates that reaction to sound, even within a species, may depend on the listener's sex and reproductive status, possibly age and/or accumulated hearing damage, type of activity engaged in at the time or, in some cases, on group size. For example, reaction to sound may vary depending on whether females have calves accompanying them, whether individuals are feeding or migrating (for example, see discussion of impacts of noise on humpback whales in Section IV.B.1.f(3)(d)2). It may depend on whether, how often, and in what context, the individual animal has heard the sound before. All of this specificity greatly complicates our ability, in a given situation, to predict the impacts of sound on a species or on classes of individuals within a species. Because of this, and following recommendations in McCauley et al. (2000), we attempt to take a conservative approach in our analyses and base conclusions about potential impacts on potential effects on the most sensitive members of a population. In addition, we make assumptions that sound will travel the maximums observed elsewhere, rather than minimums.

Ketten (1998) reported that hearing loss can be caused by exposure to sound that exceeds an ear's tolerance (i.e., exhaustion or overextension of one or more ear components).Hearing loss to a marine mammal could result in an inability to communicate effectively with other members of its species, detect approaching predators or vessels, or echolocate (in the case of the toothed whales). Hearing loss resulting from exposure to sound often is referred to as a threshold shift. This occurs when such exposure results in hearing loss causing decreased sensitivity. This type of hearing loss is called a temporary threshold shift if the individual recovers its previous sensitivity of hearing, or permanent threshold shift if it does not. Ketten (1998) reported that whether or not a temporary threshold shift or a permanent threshold shift occurs will be determined primarily based on the extent of inner ear damage the received sound and the received sound level causes. In general, whether a given species will tend to be damaged by a given sound depends on the frequency sensitivity of the species. Loss of sensitivity is centered around the peak spectra of the sound causing the damage.

Permanent threshold shifts are less species dependent and more dependent on the length of time the peak pressure lasts and the signal rise time. Usually if exposure time is short, hearing sensitivity is recoverable.

If exposure to the sound is long, or if the sound is broadband in higher frequencies and has intense sudden onset, loss might be permanent. Repeated long exposures to intense sound or sudden onset of intense sounds generally characterize sounds that cause permanent threshold shift in humans.

Ketten (1998) stated that age-related hearing loss in humans is related to the accumulation of permanent-threshold-shift and temporary-threshold-shift damage to the ear. Whether similar age-related damage occurs in cetaceans is unknown.

IV.B.1.f(3)(c) Effects of Exploration on Marine Mammals

IV.B.1.f(3)(c)1 Potential Impacts of Noise and Disturbance on Marine Mammals

During exploration, the primary potential impacts on marine mammals are associated with noise and disturbance from seismic exploration operations, construction and abandonment of delineation wells, and support-vessel traffic. Oil spills are not expected during the course of exploration. Discharges associated with drilling are likely to be diluted quickly in Cook Inlet and have only local impacts on wildlife.

Because of their reliance on hearing, there is an increasing concern about the impacts of proliferation of human-caused, or anthropogenic, sounds on marine mammals, especially on cetaceans (for example, see Richardson et al., 1995; Hoffman, 2002; Tasker et al., 1998; National Resources Defense Council, 2000 and references cited therein). The National Marine Fisheries Service (Carretta et al., 2001) summarized that a habitat concern for all whales, and especially for baleen whales, is the increasing level of human-caused noise in the world's oceans. Clapham and Brownell (1999) summarized that "…effects of ship noise on whale behavior and ultimately on reproductive success are largely unknown."

Relatedly, one of the greatest concerns associated with the impacts of oil and gas exploration and development on marine mammals has to do with potential impacts of noise on their ability to function normally and on their health.

Many marine mammals rely primarily on hearing for orientation and communication (Erbe and Farmer, 1998). For example, the scientific community generally agrees that hearing is an important sense used by cetaceans (for example see Richardson et al., 1995; National Resources Defense Council, 2000). Marine mammals rely on sound to communicate, to find mates, to navigate, to orient (Erbe et al, 1999), to detect predators, and to gain other information about their environment.

A very powerful sound at close range can cause death due to rupture and hemorrhage of tissues in lungs, ears, or other parts of the body. At greater distance, that same sound can cause temporary or permanent hearing loss. Noise can cause modification of an animal's behavior (for example, approach or avoidance behavior, or startle).

Noises can cause the masking of sounds that marine mammals need to hear to function (Erbe et al., 1999). That is, the presence of the masking noise can make it so that the animal cannot discern sounds of a given frequency and a given level that it would be able to do in the absence of the masking noise. In the presence of the masking sounds, the sounds the animal needs to hear must be of greater intensity for it to be able to detect and to discern the information in the sound.

There is increasing concern that human-caused noise in the ocean from a variety of sources could interfere with sound used by marine mammals for orientation and communication and, in some instances, could damage the hearing or otherwise harm nearby marine mammals. Such noise can be caused by factors such as ship traffic, oil production, seismic exploration, mineral mining, offshore construction, and underwater acoustic research (Erbe and Farmer, 1998). When noise interferes with sounds used by the marine mammals (for example, interferes with their communication or echolocation), it is said to "mask" the sound (for example, a call to another whale might be masked by an icebreaker operating at a certain distance away). If sounds used by the marine mammals are masked to the point where they cannot provide the individual with needed information, they can cause harm (Erbe and Farmer, 1998).

Some studies have shown that following exposure to a sufficiently intense sound, marine mammals may exhibit an increased hearing threshold, called a threshold shift after the sound has ceased (for example, Au et al., 1999; Kastak et al., 1999; Schlundt et al., 2000; Finneran et al., 2002). This shift is called a temporary-threshold shift if the threshold returns to pre-exposure levels over time. It is termed a permanent-threshold shift if the exposed animal does not regain its previous hearing threshold. Long-lasting increases in hearing thresholds, which also can be described as long-lasting impairment of hearing ability, could impair the ability of the affected marine mammal to hear important communication signals or to interpret a variety of echolocation signals (for example, for orientation, prey finding, or predator detection), as well as impair the mammal's ability to hear other important sounds such as sounds of predators, conspecifics (i.e., of the same species) or other whales (for example, sounds of breaching), or approaching vessels.

Noise from various sources has been shown to affect the behavior of many marine mammals (see Richardson et al., 1995; Kraus et al., 1997; Olesiuk et al., 1995) in ways ranging from subtle to fatal. We emphasize several points with regard to evaluating the impacts of noise and disturbance associated with OCS oil and gas exploration and development on marine mammals.

First, while there is some general information available, evaluation of the impacts of noise on marine mammal species, particularly on cetaceans, is greatly hampered by a considerable uncertainty about their hearing capabilities and the range of sounds used by the whales for different functions (Richardson et al., 1995; Gordon et al., 1998). This is particularly true for baleen whales. Very little is known about the actual hearing capabilities of the large whales or the impacts of sound on them. Research in this area is increasing. Most conclusions about likely effects are based on behavioral responses to sound, and on the assumption that they can hear the range of sounds they produce (National Marine Fisheries Service, 2002 acoustic monitoring program web site). The baleen whales are not known to echolocate.

Thus, predictions about probable impact on baleen whales generally are based on assumptions about their hearing rather than actual studies of their hearing (Richardson et al., 1995; Gordon et al., 1998; Ketten, 1998).

Ketten (1998) summarized that the vocalizations of most animals are tightly linked to their peak hearing sensitivity. Hence, it is generally assumed that baleen whales hear in the same range as their typical vocalizations, even though there are no direct data from hearing tests on any baleen whale. Functional models indicate that the functional hearing of baleen whales extends to 20 Hertz, with an upper range of 30 Hertz. Blue, fin, and bowhead whales are predicted to hear at frequencies as low as 10-15 Hertz. Species that are likely to be impacted by low-frequency sound include the baleen whales and the elephant seal. Pinnipeds typically have peak sensitivities between 1 and 20 kilohertz. Most pinnipeds do not have good hearing below 1 kilohertz.

Most species also have the ability to hear beyond their peak range. This broader range of hearing probably is related to their need to detect other important environmental phenomena, such as the locations of predators or prey. Ketten (1998:2) summarized that. "The consensus of the data is that virtually all marine mammal species are potentially impacted by sound sources with a frequency of 500 hertz or higher." This statement refers solely to the probable potential for marine mammal species to hear sounds of various frequencies. If a species cannot hear a sound, or hears it poorly, then the sound is unlikely to have a significant effect. Other factors, such as sound intensity, will determine whether the specific sound reaches the ears of any given marine mammal.

Second, the propagation of sound and the signal received at a given distance varies greatly, depending on a host of factors about the environment into which the sound is propagated, the characteristics of the location of the sound source, and the characteristics (for example, depth, orientation) of the receiver (Richardson et al., 1995; Gausland, 1998).

Third, there is a great deal of naturally occurring noise in the ocean from volcanic, seismic, wind, ice cracking and even biotic sources (see Richardson et al., 1995:Chapter 5). Some species, such as blue and fin whales, produce sounds of very high intensity.

Fourth, little data are available about how most marine mammal species, especially large cetaceans, respond either behaviorally or physically to intense sound and to long-term increases in ambient noise levels, especially over the long term. Large cetaceans cannot be easily examined after exposure to a particular sound source.

Gordon et al. (1998:Section 6.4.3.1) summarized that "Given the current state of knowledge, it is not possible to reach firm conclusions on the potential for seismic pulses to cause…hearing damage in marine mammals." Later in this review, they reach the same conclusion about the state of knowledge about the potential to cause biologically significant masking. "This review has certainly emphasized the paucity of knowledge and the high level of uncertainty surrounding so many aspects of the effects of sound on marine mammals." (Gordon et al., 1998:Section 6.12).

Fifth, considerable variation exists among marine mammals in hearing sensitivity and absolute hearing range (Richardson et al., 1995; Ketten, 1998). Because of suspected differences in hearing sensitivity, it is likely that baleen whales and pinnipeds are more likely to be harmed by direct acoustic impact from low to mid-sonic range devices than odontocetes. Conversely, odontocetes are more likely to be harmed by high-frequency sounds.

Information is better for smaller whales (for example, beluga). Even with relatively well-studied whales such as belugas, new information (for example, about the range of frequencies used for communication) can modify assumptions used in evaluating the effects of a specific noise, or group of noises, on the marine mammals of concern. All odontocetes (toothed whale) are believed to echolocate. Odontocetes are typically thought to use signals in the ranges between a few Hertz and about 20 kilohertz for communication (Richardson et al., 1995), a range that coincides with the frequency range of most underwater noises (Wenz, 1962; Richardson et al., 1995). Odontocete peak sensitivities generally are above 20 kilohertz.

For echolocation, toothed whales emit high-frequency sonar signals of up to 200 kilohertz (Richardson et al., 1995). Because of the overlap of frequencies of most underwater noise and communication signals, it generally is believed that such signals would be more affected than the high-frequency signals used for echolocation. Additionally, the signal-to-noise ratio is increased considerably (Erbe and Farmer, 1998) for echolocation signals due to the excellent directional hearing capabilities of odontocetes (Renaud and Popper, 1975; Zaitseva et al., 1980; Au and Moore, 1984) for high frequencies. However, the ability of various human noises to mask cetacean signals generally has been studied for high-frequency signals.

Erbe and Farmer (1998:1386) summarize that in "…the human and dolphin ear, low frequencies are more effective at masking high frequencies than *vice versa*; masking is maximum if the characteristic frequencies of the masker are similar to those of the signal…." They proposed that the factor most important for determining the masking effect of the noises was their temporal structure. The noise that was the most continuous with respect to frequency and time masked the beluga vocalization most effectively, whereas sounds (for example, natural icebreaking noise) that occurred in sharp pulses that left quiet bands in between and left gaps through which the beluga could detect pieces of the call. In a given environment, then, the impact of a noise on cetacean detection of signals likely would be influenced by both the frequency and the temporal characteristics of the noise, its signal-to-noise ratio, and by the same characteristics of other sounds occurring in the same vicinity (for example, a sound could be intermittent but contribute to masking if many intermittent noises were occurring).

In 1998, Erbe and Farmer (1998:1374) reported "There are no data on low-frequency directional hearing for odontocetes." Based on extrapolation from data from bottlenose dolphins evaluating directivity at high frequencies (an indirect method), the data indicated there is no directivity below 10 kilohertz.

It is not known whether (or which) marine mammals can (Erbe and Farmer, 1998) and do adapt their vocalizations to background noise. Humans adapt the loudness of their speech according to several factors, including the loudness of the ambient noise (French and Steinberg, 1947). Dahlheim (1987) reported that in noisy environments, gray whales increase the timing and level of their vocalizations and use more frequency-modulated signals.

Noise associated with oil and gas exploration could affect cetaceans or other animals by masking important sounds (for example, the calls of conspecifics, the sounds of predators, the approach of a vessel), by damaging hearing, either temporarily or permanently, again affecting the animal's ability to hear important sounds, or by damaging prey or affecting prey availability. Noise also can cause exposed individuals to alter their behavior, either by avoiding or by approaching the source of the sound. In the case of exposure to extremely high-energy sounds at close distance, noise can cause death.

McDonald, Hildebrand and Webb (1995) summarize that many baleen whales produce loud low-frequency sounds underwater a significant part of the time.

Most experiments have looked at the characteristics (for example, intensity, frequency) of sounds at which temporary threshold shift and permanent threshold shift occurred. However, it is not known what the impacts may be of repeated exposure to such sounds and whether the marine mammals would avoid such sounds after exposure even if the exposure was causing temporary or permanent hearing damage if they were sufficiently motivated to remain in the area (for example, because of a concentrated food resource). Whales often continue a certain activity (for example, feeding) even in the presence of airgun, drilling, or vessel sounds. Some people imply that such continuation indicates that the sound is not harmful to the cetacean. In many or all cases, this may be true. However, this type of interpretation is speculative. Whales, other marine mammals, and even humans, sometimes continue with important behaviors even in the presence of noise or other potentially harmful entities. Whales often fast for long lengths of time during the winter. The need to feed or to transit to feeding areas, for example, is possibly so great that they continue with the activity despite being harmed or bothered by the noise. For example, Native hunters reported to Huntington (2000) that beluga whales often ignore the approach of hunters when feeding, but at other times will attempt to avoid boats of hunters.

It is with the aforementioned caveats and level of uncertainty, but based on the best available information about impacts of OCS oil and gas noise on cetaceans from studies conducted elsewhere, that we evaluate potential impacts of oil- and gas-related noise and disturbance on cetaceans.

IV.B.1.f(3)(c)2) Potential Impacts of Exploration- and Development-Related Discharges on Marine Mammals

We refer readers to Sections IV.B.1.a(2)(c, d, and e) for a detailed discussion of drilling muds and other discharges associated with exploration drilling, with probable scenarios regarding the disposal of these substances and for discussion of the potential effects on water quality from their discharge. Any potential adverse effects on threatened, endangered, or candidate species from discharges are directly related to whether or not any potentially harmful substances are released, if they are released to the marine environment, what their fate in that environment likely is (for example, different hypothetical fates could include rapid dilution or biomagnification through the food chain), and thus, whether they are biovavailable to the species of interest.

In the proposed scenario, we assume that drilling of each exploratory or delineation well would generate about 150 dry tons of drilling muds and approximately 440 dry tons of drill cuttings for disposal. In total, the seven wells would generate 1,050 tons of muds and 3,080 tons of cuttings. These materials would be disposed of primarily at the drill site under conditions prescribed by the Environmental Protection Agency's National Pollutant Discharge Elimination System permit (Rathbun, 1986; Clean Water Act of 1977, as amended [33 U.S.C. 1251 et seq.]).

The conclusion reached in Sections IV.B.1.a, c, d, and e is that the discharge of drilling muds and cuttings and other discharges associated with exploration drilling are not expected to have any measurable effect on the overall quality of the Cook Inlet water. Within a distance of between 100 and 200 meters from the discharge point, the turbidity caused by suspended-particulate matter in the discharged muds and cuttings is expected to be diluted to levels that are less than the chronic criteria (100-1,000 parts per million) and within the range associated with the variability of naturally occurring suspended-particulate matter concentrations. Mixing in the water column would reduce the toxicity of the drilling muds that already fall into the "practically nontoxic" category to levels that would not be harmful to organisms in the water column. In general, the amounts of additives in the other discharges are expected to be relatively small (from 4 to 400 or 800 liters per month) and diluted with seawater several hundred to several thousand times before being discharged into the receiving waters. Based on the conclusions presented in the aforementioned sections, we do not expect the discharge of drilling muds and cuttings generated during exploration and development to have either direct or indirect significant impacts on threatened and endangered species. Bottom deposition of these materials can occur near drill sites. Hence, threatened and endangered species potentially could be exposed to contaminants if they tended to occupy sites very near to the drill site, or fed on prey that foraged very near to the drill site. The potential for such exposure probably is the greatest for certain classes of sea otters (males) and possibly belugas. However, the intense flushing activity in Cook Inlet should result in rapid dilution of discharged materials. Thus, any potential effects should be localized and relatively minor, affecting relatively small numbers of individuals. It is likely that the amount of habitat affected would be small compared to that available to the species for foraging.

IV.B.1.f(3)(d) Effects of Exploration on Cetaceans

IV.B.1.f(3)(d)1) Effects of Exploration on Blue Whales, Sperm Whales, Right Whales, and Sei Whales

Several of the threatened and endangered cetacean species that we evaluated are unlikely to appear within the proposed Cook Inlet sale area or in areas that could be impacted by activities within the inlet (for example, areas that are "downstream" of where potential development associated with the lease sale would occur). Available evidence indicates that blue and sperm whales are highly unlikely to inhabit the Cook Inlet program area at any time of the year. As summarized in the affected environment section, available evidence indicates that blue, sperm, and North Pacific right whales do not typically breed, calve, feed, or migrate through areas that would be likely to be impacted by oil and gas exploration and development within Cook Inlet. While blue, sperm and sei whales are seasonally present in the Gulf of Alaska, they are typically offshore and relatively rare. Therefore, it is extremely unlikely that even individual blue whales would be affected in any significant way by exploration activities associated with the Proposed Action within Cook Inlet.

North Pacific right whales do occur in the Gulf of Alaska. Any impacts on the health, reproduction or survival of individuals of this species would be significant because of their extremely small population size. As summarized elsewhere, this area clearly was an important part of their historic range. Right whales are extremely rare in this area, however. More importantly, there is no evidence indicating that North Pacific right whales ever inhabited areas within Cook Inlet or Shelikof Strait (see summary in National Marine Fisheries Service biological opinion for OCS Sale 88 in 1984 at the beginning of this section). Thus, based on available information, we expect no impacts of exploration or development on this species.

Sperm whale females and calves are not described as inhabiting regions of the Gulf of Alaska adjacent to the Cook Inlet region. Therefore, it is unlikely that even individual sperm whale females or calves could be affected in any way by exploration activities associated with the Proposed Action within Cook Inlet. It also is unlikely that there would be any major affect on male sperm whales. However, there is a small possibility that there could be temporary, probably minor effects on male sperm whale behavior in the Gulf of Alaska due to seismic exploration occurring in areas when sound transmission to the gulf was unimpeded by land (for example, potentially in the Kennedy Entrance area or in areas just west of the entrances). Mate et al. (1994) reported data that indicated sperm whales may be especially sensitive to seismic surveys and that, in the Gulf of Mexico, sperm whale abundance changed significantly following the initiation of seismic surveys. For 4-5 days prior to the surveys, density of whales was 0.092 whales per kilometer). During the first 2 days of the seismic operation, sperm whale abundance dropped to 0.038 whales per kilometer and then to 0.0 whales per kilometer for the following 5 days. Sperm whales were observed around the periphery of the seismic area during the first 2 days of activity. Survey effort for the last 5 days indicated one group of sperm whales 61 kilometers from the seismic survey area and another 56 kilometers away. In the southern Indian Ocean, sperm whales sometimes, but not always, ceased calling when seismic pulses were received from an airgun array over 300 kilometers away (Bowles et al., 1994). Richardson et al. (1995) summarized that sperm whales may exhibit behavioral reactions to seismic pulses at long ranges.

In summary, no effects are expected on blue whales or on sperm whale females or calves, because they do not tend to occur in areas where they could be impacted by either noise, disturbance, or discharges associated with OCS oil and gas exploration in Cook Inlet. No important effects are expected on male sperm whales.

Individual sei whales are very rarely observed in Shelikof Strait and waters adjacent to Kodiak Island. There is one recorded sighting of sei whales in the Cook Inlet program area. Thus, as with blue and sperm whales, it is unlikely that sei whales would be in areas impacted by any noise, discharge, or disturbance associated with OCS oil and gas exploration within that area. It is possible, but based on the frequency of sightings, unlikely, that an individual or very small number of sei whales could hear sounds associated with exploration activities, particularly any in the Barren Islands region, or the southern part of the proposed Program areas nearest to Shelikof Strait. However, impacts of such noise detection are likely to be behavioral (for example, change of course), transitory, and, given the rarity of their occurrence in the area, of negligible impact to the population.

No population impacts are plausible for this species, which does not typically inhabit the program area or areas adjacent or downstream of where proposed activities could occur.

IV.B.1.f(3)(d)2) Effects of Exploration on Humpback and Fin Whales

Noise associated with seismic exploration conducted in the lower inlet, particularly in or near the entrances to Cook Inlet, including the area around the Barren Islands, could affect the behavior of humpback and possibly fin, and less likely, beluga whales, potentially affecting the use of (for humpbacks) or transit to important feeding areas in Shelikof Strait and the western bays of Kodiak Island. Long-term impacts of OCS oil- and gas-related noise on the hearing abilities of individual marine mammals are unknown. Information about the hearing capabilities of large baleen whales is mostly lacking. As noted previously, the assumption is made that the area of greatest hearing sensitivity are at frequencies known to be used for intraspecific communication. However, because real knowledge of sound sensitivity is lacking, we assume in our analyses that sensitivities shown by one species of baleen whale also could apply to another. This analysis is conservative, especially when using studies on a species such as the humpback, which uses a large sound repertoire in intraspecific communication, to infer possible impacts on other species such as the fin whale. However, lacking more detailed knowledge of hearing capabilities of these large whales, a conservative analysis is prudent.

Humpback whales probably are the most likely of the baleen whales to be impacted by OCS oil and gas exploration and development activities in Cook Inlet. This is because they commonly occur seasonally in areas where seismic activity could occur; they feed in areas where exploration, development and production could occur; and some segments of humpback populations have a demonstrated sensitivity to some types of noise associated with exploration.

In the late spring, summer, and early autumn months, humpback whales feed in areas around the Barren Islands, Kennedy Entrance, and other areas within the southwestern portion of the proposed planning area, in waters in the northwest corner of Shuyak Island, and in Shelikof Strait (an area downstream of activities in Cook Inlet). All of these areas have the potential to be impacted by some activity of either exploration or development and production. With respect to exploration, the areas within or immediately adjacent to the program area are most likely to be impacted by exploration activities such as noise and disturbance. During a research cruise in late May 2001, Sease and Fadely (2001) observed hundreds of humpback whales off the Barren Islands. Large feeding aggregations of humpback whales also occur along the west coast of Kodiak, but these areas are not likely to be impacted by exploration activities in Cook Inlet. However, these same whales may move to other feeding locations around the Kodiak Archipelago. Thus, the total number of humpback whales that are likely to be impacted by exploration activities is unknown but could range in the hundreds during periods when large aggregations of this species are feeding near the Barren Islands.

Humpback whales make a variety of sounds. Their song is complex, with components ranging from less than 20 Hertz to 4 kilohertz, and occasionally up to 8 kilohertz (Richardson et al., 1995). Songs can be detected by hydrophones at distances up to at least 13-15 kilometers (Helweg et al., 1992). These songs can last as long as 30 minutes. However, they are typically heard on low-latitude wintering grounds. They occasionally have been heard on northern feeding grounds (for example, McSweeney et al., 1989). Thus, it is unlikely that noise associated with exploration or development would interfere with the hearing of this song. Most sounds produced by males in winter extend from 50 Hertz to greater than 10 kilohertz with most energy below 3 kilohertz (Silber, 1986). On high-latitude summer grounds, humpbacks are less vocal. Calls are made while feeding and may serve to manipulate prey and as “assembly calls” (Richardson et al., 1995). These calls are at about 20-2,000 Hertz.

McCauley et al. (2000) recently demonstrated that pods of humpback whales containing cows involved in resting behavior in key habitat were more sensitive to airgun noise than males and than pods of migrating humpbacks. In 16 approach trials carried out in Exmouth Gulf, off Australia, he found that pods of humpbacks with females consistently avoided a single (not an array) operating airgun at an average range of 1.3 kilometers (McCauley et al., 2000). McCauley et al. (2000:692) summarized:

> The generalised response of migrating humpback whales to a three-dimensional seismic vessel was to take some avoidance maneuver at greater than 4 kilometers then to allow the seismic vessel to pass no closer than 3 kilometers. Humpback pods containing cows which were involved in resting behaviour in key habitat types, as opposed to migrating animals, were more sensitive and showed an avoidance response estimated at 7-12 kilometers from a large seismic source.

McCauley et al. (2000) observed a startle response in one instance. Within the key habitat areas where resting females and females and calves occurred, the humpbacks showed high levels of sensitivity to the airgun. The mean airgun level at which avoidance was observed was 140 decibels re 1 micropascal root mean square, the mean standoff range was 143 decibels re 1 micropascal root mean square, and the startle response was observed at 112 decibels re 1 micropascal root mean square. Standoff ranges were 1.22-4.4 kilometers. The levels of noise at which a response was observed are considerably less than those published for gray and for bowhead whales (see below). They were also less than those observed by McCauley et al. (2000) in observations made from the seismic vessel operating outside of the sensitive area where whales were migrating, not engaged in a sensitive activity.

McCauley et al. (2000) summarized that in their experience, cow/calf pairs are more likely to exhibit an avoidance response to a sound to which they are unaccustomed. They recommend that "…any management issues related to seismic surveys should consider the cow/calf responses as the defining limits" (McCauley et al., 2000:697). They also recommend that management decisions distinguish between whales that are in a "key habitat type" (McCauley et al., 2000:698) and those that are migrating through an area. They list areas used for feeding, resting, socializing, mating, calving, or other key purposes as "key habitats." While detailed data on the behavior of humpbacks in the areas discussed above are not available, many of the areas are known (for example, see Figure III.B-1 and Section III.B.1 - Lower Trophic-Level Organisms) to seasonally contain concentrations of phytoplankton, zooplankton, and associated zooplankton predators. They are important feeding areas for large numbers of birds, baleen whales, and Steller sea lions.

McCauley found that adult male humpbacks were much less sensitive to airgun noise than were females. At times, they approached the seismic vessel. McCauley et al. (2000) speculated that males that did so may have been attracted by the sound because of similarities between airgun sounds and breaching signals. Based on the aforementioned, it is likely that humpback whales feeding in areas within and adjacent to areas within the program area could have their movement and feeding behavior affected by noise associated with seismic exploration. It also is possible that female humpbacks also would show avoidance behavior to noise and disturbance activities associated with construction, drilling, and other noise generating aspects of exploration discussed above. The most likely to be impacted are females and calves. This potential impact would be seasonal, since humpbacks are not common in these areas during the winter.

Cetaceans, including humpback whales, fin whales, or belugas, and other species that are in the vicinity when delineation wells are dismantled could be seriously injured or even killed if explosives are used in the dismantling. Ketten, Lien and Todd (1993) and Lien et al. (1993) reported extensive damage to the ears of humpbacks that died after underwater explosions. However, these effects were very local. Humpbacks that were several kilometers from the blast and were at the surface showed no significant behavioral impacts.

Humpback whales near the Barren Islands and the southern portions of the Cook Inlet program area also could be negatively affected by vessel transport and construction activities. However, this area has a high volume of fishing- and tourism-related vessel traffic in the summer months when the whales are present. The incremental addition of noise from two vessels per day associated with the Proposed Action is unlikely to add significantly to this existing noise.

Humpback whales and fin whales could be disturbed by aircraft noise associated with development and exploration. Based on their distributions, humpbacks are more vulnerable to this type of disturbance than fin whales. Shallenberger (1978) reported that some humpbacks were disturbed by overflights at 305 meters, whereas others showed no response at 152 meters. As with the response to airgun noise, pods varied in their response. Humpbacks in large groups showed little or no response but some adult-only groups exhibited avoidance (Herman et al., 1980). Other authors report no response (for example, Friedl and Thompson, 1981). Due to concerns about the impacts of helicopters in Hawaiian waters, helicopters are prohibited from approaching within a slant range of 1,000 feet or 305 meters from humpbacks (National Marine Fisheries Service, 1987).

Available data indicate that fin whales also could, but are probably less likely than humpbacks to, be affected by noise and disturbance associated with exploration or development primarily because of their distribution. Based on available data, they do not occur as frequently or in as high abundance in areas within or directly adjacent to the Cook Inlet program area where such impacts could occur. However, they occasionally are sighted further into the inlet. They appear to be year-round inhabitants of Shelikof Strait and bays off of Kodiak and Shuyak islands, as well as bays across the strait along the Alaska Peninsula. Thus, small numbers of individuals could be affected by noises associated with seismic exploration, drilling, or vessel transit, for example. However, such effects are likely to be limited to a few individuals and not affect the population as a whole.

Richardson et al. (1995) reported that bowhead whale avoidance behavior has been observed in half of the animals when exposed to 115 decibels root mean square re 1 micropascal broadband drillship noises. However, reactions vary depending on the whale activity, noise characteristics, and the physical situation (Richardson and Greene, 1993).

Richardson et al. (1995) stated that the most common fin whale sound is a 20-Hertz sound that downsweeps from about 23 Hertz to about 18 Hertz over the course of about 1 second. The usual bandwidth is 3-4 Hertz (Payne and Webb, 1971). Calls believed to be from fin whales have been detected at distances of up to 185 kilometers (Cummings and Thompson, 1971) and can be detected at much greater ranges (D. Mellinger, cited as pers. commun. in Richardson et al., 1995). Richardson et al. (1995) summarized that fin whales also produce sound up to 150 Hertz.

Data are not available on responses of fin whales to airguns. Data are not available to determine whether airgun sounds produced within the program area would be detectable by fin or humpback whales in Shelikof Strait.

IV.B.1.f(3)(d)3) Effects of Exploration on Beluga Whales

Beluga whales may inhabit areas in which exploration-related noise and disturbance could occur. However, available data (summarized in the affected environment section) indicates at present their use of such areas is low. In summer, belugas tend to be concentrated in the extreme upper inlet. While their distribution is more dispersed in the winter, they are typically seen in more coastal areas, rather than in OCS regions farther from shore (see Figure III.B-2). However, the National Marine Fisheries Service researchers (for example, Laidre et al., 2000; Moore et al., 2000; and Rugh, Shelden, and Mahoney, 2000) report that the current distribution of this stock appears to have contacted from its previous range and that sightings in the lower inlet currently are rare. Rugh, Shelden, and Mahoney (2000) reported that, since 1995, only one live and one dead beluga has been observed in areas south of the Forelands in the lower inlet during aerial surveys conducted in June and July. However, naturalists in the Homer area report seeing small numbers of belugas in August at the head of in Kachemak Bay in two successive recent years (Field, 2002, pers. commun.). The reasons for the postulated range contraction are unclear. If such range contraction is, in part, linked to the decline in abundance, their range might again expand as the population increases in numbers. Such expansion would increase the likelihood that beluga would be in areas where noise and disturbance from oil and gas were present. In Cook Inlet, it is likely that, due to weather, seismic exploration would be limited to a period between May and mid-September.

Beluga whales could be disturbed and their behavior modified due to noises associated with seismic exploration. Incidental to seismic surveys, high-frequency noise (across the bandwidth up to 22 kilohertz) is produced, which may overlap with frequencies used by toothed dolphins (Richardson et al., 1995). The Joint Nature Conservation Committee of the United Kingdom (Stone, 2001) reports there is some evidence of seismic survey disturbance of dolphins (Goold, 1996; Stone, 1997, 1998). The hearing of the beluga extends to at least as low as 40-75 Hertz, but their sensitivity at these low frequencies may be poor (summarized in Richardson et al., 1995). Turl (1993) concluded that if they are in the near field of an acoustic source, beluga may be more sensitive to some combination of low-frequency particle motion and pressure fluctuation than is evident from their relative insensitivity to low-frequency sounds at distance. Their high-frequency hearing is exceptionally good and they use high frequencies for echolocation. Thus, they are sensitive to high-frequency noise and they have a high need to have good sensitivity in the high-frequency ranges. Richardson et al. (1995) report that the hearing range of small- to moderate-sized toothed whales tested (including beluga) extended up to 80-150 kilohertz in some individuals of all tested species. Odontocetes have their best sensitivity in the middle frequency range where their hearing is very acute (for example, Figure 8.1 of Richardson et al. (1995) indicated that the underwater hearing of beluga ranged from about 30 Hertz to slightly over 100,000 Hertz. At about 15,000 Hertz, the hearing sensitivity of the beluga was exceptionally acute (approximately 39 decibels re 1 micropascal). Richardson et al. (1995) pointed out that the estimated auditory thresholds for many marine mammals may be too high for frequencies below 1-10 kilohertz. Using evoked potential methods, Klishin, Popov, and Supin (2000) found that like other odontocetes, the belugas audiogram is U-shaped with high sensitivities from 32 kilohertz to 108 kilohertz (less than 75 decibels re 1 micropascal) with the lowest threshold of 54.6 decibels at 54 kilohertz. This threshold is a few decibels higher than that found psychophysically.

Richardson et al. (1995:292) summarized that while most of the energy from airgun arrays is below 100 Hertz and, thus, below the frequencies of the optimum hearing and calls of toothed whales, the pulses often include energy up to 200-500 Hertz, and that "…despite the apparently poor low-frequency hearing of odontocetes, airgun pulses may often be audible to them out to a radius of 10-100 kilometers…."

Finneran et al. (2002) detected temporary shifts of 7 and 6 decibels in masked hearing threshold in a 32-year-old beluga whale at 0.4 and 30 kilohertz, respectively, about 2 minutes after exposure to a single underwater impulse (with peak pressures of 160 kilopascals, peak-to-peak pressures of 226 decibels re 1 micropascal, and total energy fluxes of 186 decibels re 1 micropascal squared second) from a seismic watergun (note: not an airgun). These thresholds returned to within 2 decibels of the pre-exposure value within 4 minutes of exposure. Finneran et al. (2002) reported that they used waterguns instead of airguns, because watergun impulses contain more energy at higher frequencies where odontocete hearing thresholds are relatively low. They noted that a 6-decibel criterion for defining a temporary shift in masked hearing threshold was considered, based on previous threshold data on the animals, to be the minimum shift that was clearly larger than day-to-day or session-to-session levels of variability. Finneran et al. (2002) also noted that the presence of masking noise may result in elevated hearing thresholds (as it does in humans) and, thus, that it is possible that lacking the masking noise, a larger temporary threshold shift would have been detected. With the masking noise present, no temporary shift in masked hearing threshold was detected at a peak pressure of 207 kilopascals (30 pounds per square inch) in a 36-year-old bottlenose dolphin. Keeping in mind the caveat of the masking noise, in bottlenose dolphins, no temporary shift in masked hearing threshold was detected at the highest exposure conditions. Finneran et al. (2002) compared the results of their study to those of previous studies. Au et al. (1999) reported a 12-18 decibel temporary-threshold shift in a bottlenose dolphin exposed to 50 minutes of octave band noise centered at 7.5 kilohertz. Finneran et al. (2000) showed no temporary shift in masked hearing thresholds after exposure to single impulses, and Schlundt et al. (2000) found temporary shift in masked-hearing thresholds of 6 decibels or larger in belugas and dolphins exposed to 1 second oureLisa, maybe define this for the lay reader? tones between 3 and 75 kilohertz. Finneran et al. (2002) concluded that the use of a single sound-pressure level, without regard to signal duration, is an inappropriate metric to predict or describe a temporary threshold shift in hearing.

In Cook Inlet, production-platform personnel have reported that belugas are seen within 9 meters of some rigs and that steady noise does not appear to disturb them (Gales, 1983; McCarty, 1982). Richardson et al. (1995) summarized that belugas are attracted to flare booms, possibly because flares attract salmon. Existing data indicate that the behavior of belugas potentially could be affected by noise associated with drilling or disturbance, or both, associated with emplacement of temporary or permanent drilling units. Results (Richardson et al., 1995:282-83) from both field and captive research suggest that beluga response to such noise can be variable. For example, during experimental playbacks of steady, low-frequency drilling noise into leads north of Alaska in the spring, beluga showed no overt reactions until they were within 200-400 meters, despite the fact that the noise was detectable on hydrophones up to 5 kilometers away. Some belugas hesitated within 200-400 meters but continued until within 200 meters of the sound projector (Richardson et al, 1995). Fraker (1977a,b) reported that belugas were regularly seen within 100-150 meters of artificial islands where drilling was occurring. However, belugas swimming along an ice lead modified their course within 1 kilometer of a stationary drillship and showed more active avoidance when support vessels were in transit near the drillship (Norton, Fraker, and Fraker, 1982). During experimental playbacks of sounds from a semisubmersible drillship (SEDCO 708), at 1.5 kilometers, belugas in a river usually swam faster in the same direction as they had been prior to the playback. Their rate of respiration sometime increased (Stewart, Aubrey, and Evans?, 1983). During two tests, belugas responded by rapid swimming and, in one case, course reversal within 50-75 kilometers and 300-500 meters of the sound projector. Richardson et al. (1995), citing Stewart et al. (1982) summarized that the reaction of belugas to drilling noise was less severe than to motorboat noise.

Beluga whales also can be negatively affected by noise associated with ships and high-speed motorboats. Beluga whales have exhibited avoidance behaviors at ship noise levels of only 94-1-5 decibels root mean square re 1 micropascal in the 20-1,000-Hertz band from ships 35-50 kilometers distant (Finley et al., 1990). Belugas have been observed to immediately move downriver away from, and in response to, outboard motor noise (Stewart, Aubrey, and Evans, 1983). Belugas have been observed to startle and leave the area in response to boats and barges transiting in a whale concentration area (Fraker, Sergeant, and Hoek, 1978). The increase in boat traffic from proposed exploration activities is expected to range between 0.6-1.25 round trips per day (18-38 per month) between harbor facilities at Nikiski and the drill platform. Given existing levels of boat traffic in Cook Inlet, especially during the summer and early autumn months when activity would be concentrated, it is unlikely that this level of increased activity would result in discernible disturbance of any belugas that happened to transit in areas where such boat traffic was occurring.

Erbe and Farmer (1998) recorded sounds from a medium-sized (100-meter length, 20-meter breadth, 12-megawatt total power) icebreaker operating in the Beaufort Sea at 5 kilometers and evaluated the thresholds at which sounds from icebreaker masked typical, recorded beluga vocalizations as discernible by a captive beluga. Noise from the bubbler system exhibited the strongest masking effect, with a critical noise-to-signal ration of 15.4 decibels. At noise-to-signal ratios greater than 18.0 decibels, propeller cavitation noise completely masked the vocalization. Noise associated with natural icebreaking interfered the least with the beluga's ability to hear the signal, with a threshold at 29.0 decibels (Erbe and Farmer, 1998).

Belugas could be disturbed by noise and disturbance from exploration and development-related aircraft, especially helicopters. Belugas reacted to aircraft flying at 150-200 meters by diving for longer periods, reducing surfacing time and sometimes swam away (see references cited in Richardson et al., 1995). They did not respond to aircraft at 500 meters. Richardson et al. (1991) found variable reactions to turbine helicopters and fixed wing aircraft in offshore waters near Alaska. Some individuals exhibited no discernible response even when the aircraft was within 100-200 meters, whereas other individuals dove abruptly, looked upward, or turned sharply in response to aircraft at altitudes up to 460 meters. In shallow summering areas, belugas sometimes respond to aircraft by diving or swimming away (Finley et al., 1982; Gales, 1982; Caron and Smith, 1990).

As noted previously, it is sometimes implied that the failure of a whale to modify its behavior, especially when feeding, is evidence that the whales is not significantly affected by the noise. This may be true in some or all cases. However, it also is possible that whales that are engaged in an especially critical behavior, such as seasonal feeding, may be sufficiently motivated to be in an area that they remain despite the noise, even if the noise is masking communication, temporarily damaging hearing capabilities, or interfering with the detection of other important sounds. Whales may remain in an area even though a clearly harmful factor is present. For example, Native hunters in Cook Inlet have reported that while belugas generally have become more wary in Cook Inlet when feeding in shallow water, they ignore a hunter's approach (Huntington, 2000).

Moore et al. (2000) concluded that the isolated nature of the Cook Inlet beluga, and the fact that members of the population appear to spend the majority, if not all, of the year in the inlet, renders it highly vulnerable to human-caused changes in its environment in Cook Inlet. However, while there are potential sources (for example, noise, disturbance, and discharges) of impacts from OCS oil- and gas-related activities on belugas, the Cook Inlet population of beluga whale has shared Cook Inlet with oil and gas exploration and development for decades, with no apparent negative population-level effects. There is relatively broad agreement that overhunting by Alaskan Native hunters was the primary cause of the recent decline. While other factors may have contributed, there is no evidence linking noise and disturbance from OCS oil and gas activity, or noise and disturbance from oil and gas development in State waters to the recent decline. The fact that prior to overhunting, beluga whales in Cook Inlet coexisted in the inlet with no obvious ill effect suggests it is unlikely that relatively small amounts of additional exploration during the summer and autumn in areas outside of the current primary use zones of this population will cause significant negative impacts on this population.

IV.B.1.f(3)(e) Effects of Exploration on Steller Sea Lions

The effect of noise related to OCS oil and gas exploration and development on Steller sea lions is not well studied. Audiograms are not available for Steller sea lions, but behavioral audiograms are available for the California sea lion and the northern fur seal. Richardson et al. (1995) report that pinnipeds tend to have lower best frequencies, lower high-frequency cutoffs, and poorer sensitivity at the best frequencies, than do odontocetes. The high-frequency cutoff for the two otariid seal species studied was 36-40 kilohertz (Schussterman 1981a) and their sensitivity at low frequencies was intermediate. The California sea lion had best sensitivity of about 80 decibels at 2 and 16 kilohertz. Sensitivity at 100 Hertz was 116-120 decibels and about 85 decibels at 1 kilohertz. Sensitivities in air are about 32-36 Hertz. The in-air sensitivity of pinnipeds apparently decreases as frequency decreases below 2 kilohertz (Richardson et al., 1995).

The National Marine Fisheries Service (67 *FR* 35793) reported that seals and sea lions are believed to be less likely to be harmed by underwater noise than cetaceans, and they have been observed swimming in the bubbles of large seismic airgun arrays. The National Marine Fisheries Service states (67 *FR* 35793) that it has been determined through scientific workshops that pinnipeds would need to be closer than 190 decibels (root mean square) before injury.

There are recent data indicating that noise from seismic exploration may influence the behavior of Steller sea lions when they are in the water. In March 1998, the U.S. Geological Survey conducted seismic surveys on Puget Sound to investigate earthquake hazards (SHIPS project)Lisa, is this going to be a citation?. The surveys measured responses to a towed array of 12-16 airguns with a maximum theoretical sources level of about 260 decibels (re 1 micropascal at 1 meter). Bain (2002) reported that this species (no details on numbers, age, or sex were provided) was recorded in areas with sound levels up to 170 decibels but was moving away from the airguns at this level. California sea lions were observed moving away from the airguns at the lowest levels but were recorded within the 180-decibel contour. After evaluating the behavioral response of pinnipeds (i.e., California sea lion, Steller sea lion, harbor seal), a baleen whale (i.e., California gray whale), and odontocete cetaceans (i.e., Dall's porpoise and harbor porpoise), Bain (2002) concluded that the behavioral response to airgun noise did not correlate well with expectations based on hearing sensitivity to low sound. Based on available information, it is unlikely that Steller sea lions would be physically harmed by seismic-survey operations. However, based on the findings of Bain (2002), behavioral displacement from specific sites could occur.

Because of the behavior of sound transmission, and required prohibitions against activities that would disturb Steller sea lions on their rookeries and haulouts, it is unlikely that seismic operations would disturb sea lions on land. This basic conclusion also was reached by the National Marine Fisheries Service in 1993 in its biological opinion regarding Cook Inlet Sale 149.

Airborne sounds from aircraft are especially relevant to Steller sea lions. Sea lions pup on land, and pups are vulnerable to trampling if adults are panicked by low aircraft noises. Thus, startling noise at rookeries can lead to significant mortality. Calkins (1979) reported that the reaction of Steller sea lions to aircraft is variable. Some or all of the animals may be frightened into the water by the aircraft. "Immatures and pregnant females are more likely to enter the water than are territorial males and females with small pups. Withrow et al. (1985) saw 1,000+ animals stampede off a beach in response to a Bell 205 helicopter greater than 1.6 kilometers away" (Richardson et al., 1995:245). Richardson et al. (1995) summarized that pinnipeds hauled out for pupping or molting are most responsive to aircraft. "They react to aircraft sound by becoming alert and often by rushing or (when on ice) slipping into the waters" (Richardson et al., 1995:243).

In recognition of this vulnerability to loud and startling noises, Steller sea lion critical habitat has been defined to include a terrestrial zone that extends 3,000 feet landward from the baseline or base point of each Steller sea lion major rookery or major haulout and an air zone that extends 3,000 feet above the terrestrial zone, as measured at sea level around them. Assuming aircraft flying to any platforms maintain sufficient distances from these rookeries, based on recognition of this critical habitat, it not likely this form of disturbance would have a major impact on Steller sea lions. However, given observations by Withrow et al

(1985) cited above, it is possible that sea lions could be negatively affected by oil- and gas-activity-related helicopters (and possibly by other noise) operating at further distances. Under the proposed scenario, one to two helicopter trips per day would be made to oil and gas operations from Kenai or other sites along the western Kenai Peninsula shore. In most of the proposed Cook Inlet multiple-sale area, these flights would not require transit over any terrestrial components of Steller sea lion critical habitat and adverse effects could easily be avoided. The greatest potential for such disturbance could come from helicopters transiting to blocks on the far side of the Barren Islands if flights originated on the Kenai Peninsula and stayed, as geography permits, near land until crossing of the entrances of Cook Inlet was required to reach drill (or production) sites on the far sides of the Barren Islands.

Major rookeries in and near the program area include Outer Island, Sugarloaf Island, Marmot Island, Chirikof Island, and Chowiet Island. There are several major haulouts in and near the program area, 20-nautical-mile aquatic zones, and an aquatic foraging area in Shelikof Strait. All of these are part of Steller sea lion critical habitat.

Support-vessel traffic would be unlikely to adversely affect these habitats as long as operators avoided transiting near to the rookeries or haulouts or deliberately approaching sea lions in the water.

Critical habitat of Steller sea lions is unlikely to be impacted by exploration activities. As noted above, terrestrial zones are legally protected from activities degrading them by disturbance. Shelikof Strait was designated as critical habitat because of its proximity to major rookeries and important haulouts, its use by foraging sea lions and its value as an area of high forage-fish production. Any adverse impacts of oil and gas development that adversely affect the production and availability of prey to Steller sea lions in this and other critical habitat would adversely modify the habitat. Oil spills are not expected to occur during exploration. Because drilling muds apparently are rapidly diluted (see analyses in Sections IV.B.1.a(2)(c, d and e), they are not expected to be toxic to planktonic larvae (Rice et al., 1983). Because of this high dilution factor, it is unlikely that drilling-rig discharges would adversely impact pollock or other Steller sea lion prey production (National Marine Fisheries Service, 1993).

IV.B.1.f(3)(f) Effects of Exploration on the Southwest Alaska Stock of Sea Otters

Oil and gas exploration in the proposed Cook Inlet Planning Area is not likely to have significant impacts on the Southwest Alaska stock of sea otters in areas within or near the program area. No oil spills are expected as a result of exploration. While noise and disturbance associated with OCS oil and gas exploration could have local effects on the behavior and possibly the distribution of sea otters in this area, they are unlikely to have significant population impacts. Based on information provided by the Fish and Wildlife Service in comments on a draft of the EIS, "…GIS analysis suggests that the geographic overlap between the proposed lease sale area and sea otters from the southwest Alaska" Distinct Population Segment "is minimal." They reported that during a survey conducted by the U.S. Geological Survey, Biological Resources Division

> …the high-density survey stratum covered 3,968 km^2 if sea otter habitat adjacent to lower western Cook Inlet from Cape Douglas in the south, northward to latitude 59º58'21." While approximately 35 percent of this survey stratum…lies within the boundaries of the proposed Cook Inlet lease sale area, few sea otters were observed there. For the entire lower western Cook Inlet survey area, observers recorded …a total of 544 otters, but only a single otter was recorded within the proposed lease sale area. The vast majority of sea otter sightings occurred southwest of Augustine Island." However, it is unclear from the available information whether this observed distribution tends to change significantly with season, between years, based on weather patterns, or due to other factors.

There is little information on the effects of noise associated with oil and gas exploration on sea otters. Their production and use of sound underwater has not been studied. Airborne sounds are diverse and include high-pitched screams, whines, whistles, deep-throated growls, cooing, chuckles, and snarls (Kenyon, 1981). Mothers and their pups communicate by calling, and both call to one another if separated. Most of the sounds in these mother-pup communications are 3-5 Hertz, but there are higher harmonics. Sandegren, Chu, and Vandervere (1973) recorded these calls from a distance of 50 meters in air. It is not known how far sea otters can hear these sounds.

Boat traffic associated with OCS oil and gas exploration activity could disturb sea otters in specific areas. In summer, these impacts are likely to be insignificant compared to the quantity of fishing, tourism, shipping, and other boat traffic in the region. In winter, boat traffic in a remote region could have local impacts on distribution of females and pups. While male sea otters sometimes habituate to heavy boat traffic, female sea otters, particularly those with pups, are sensitive to disturbance. Garshelis and Garshelis (1984) reported that sea otters in Prince William Sound avoided waters with frequent boat traffic but reoccupy these areas when boats are less frequent. Rotterman and Monnett (2002) concluded that disturbance after the *Exxon Valdez* oil spill was sufficient to keep sea otters from feeding habitat in certain bays in oiled areas of Prince William Sound. Udevitz et al. (1995) reported that about 15% of sea otters along boat survey transects are not detected because they move away from the approaching boat.
Boat traffic could disturb resting patterns of sea otters. Sea otters in Alaska haul out regularly. Sea otters that are hauled out will often move into the water with the approach of a boat. Garrott, Eberhardt, and Burn (1993) reported that sea otters on shore would move into the water with approach of a single small motorboat moving parallel to and 100 meters from shore.

Available data do not indicate that sea otters are likely to be seriously impacted by seismic exploration. Riedman (1983, 1984) reported no evident disturbance reactions by sea otters in California coastal waters in response to noise from a full-scale array of airguns (67 L) and a single airgun. No disturbance was noted either when the operating seismic ship passed as close as 1.85 and 0.9 kilometers to sea otters. Sea otters continued to feed, groom, interact with pups, rest, and to engage in other normal behaviors. Riedman (1983, 1984) reported there was also no apparent reaction to the single airgun. Riedman (1983) cautioned that there are no data for the reactions of sea otters more than 400 meters offshore.

Riedman (1983, 1984) reported no evidence of changes in behavior of sea otters during underwater playbacks of drillship, semisubmersible, and production platform sound. Most of the animals studied were 400 or more meters from the source of the sound. Foraging otters continued to dive and feed.

Drilling muds could have localized effects on sea otter prey. Individual sea otters that preyed at or very near the site of drilling could be exposed to components of these muds. Because of the aforementioned tendency for sea otter females to avoid sites of high disturbance animals that foraged at such sites would likely be males. However, it is unlikely that population impacts would occur from such exposure.

There are few data available on which to evaluate the impacts of well-abandonment activities on marine mammals, including sea otters.

Available data indicate that of sea otters within the Southwest Alaska stock, only those sea otters in the western side of Cook Inlet near and within Kamishak bay are most likely to be affected by exploration activities. None of the other otters throughout the huge range of this stock, which extends form the north side of Cook Inlet to the western tip of the Aleutian Islands, could possibly be impacted by activities during exploration.

IV.B.1.f(3)(g) Effects of Exploration on Endangered Species Act-Protected Birds

IV.B.1.f(3)(g)1 Effects of Exploration on the Aleutian Canada Goose

Overall effects of OCS oil and gas development in the Cook Inlet program area on the Aleutian Canada goose are expected to be minimal, affecting none, or at most, a very small part of the total population.

Because noise, disturbance, and discharges associated with exploration, development, or production that could result from this sale would be far removed from the Semidi Islands where the nearest breeding population of this subspecies exists, Aleutian Canada geese are not expected to experience any effect from such activities. As discussed in the affected environment section, the Aleutian Canada goose does not nest within or near, or typically migrate through, the Cook Inlet sale area. A few sightings recently have been reported from the Kodiak Archipelago and in areas near to the proposed Cook Inlet sale area near Anchor Point. Thus, it is hypothetically possible that an individual, pair, or small number of these geese could be temporarily impacted by noise (for example, a low-flying airplane) associated with the Proposed Action. However, the probability of such impact is negligible, and any impacts from such effect would be expected to be negligible. Based on available information, it is unlikely that even an individual would be impacted by noise, disturbance, or discharges associated with oil and gas exploration activities in Cook Inlet.

Available information indicates that any potential discharge associated with exploration in the Cook Inlet program area would be diluted quickly and, thus, would not be likely to impact individuals far from the site of discharge.

If an oil spill occurred in the proposed sale area, it is unlikely that Aleutian Canada geese would be oiled. The combined probability (expressed as percent chance) of one or more greater than or equal to 1,000-barrels spills occurring and contacting the Semidi Islands and Kodiak Island bays is low, and geese do not typically occupy habitats likely to be oiled.

However, if a spill occurred and Aleutian Canada geese were exposed to oil, the same general effects would be expected as noted for the short-tailed albatross. Geese could be vulnerable to oil spills during the breeding season if they spent time in the intertidal zone or in or flying low over waters surrounding the nesting island in the Semidi Islands southwest of the proposed sale area. However, the lack of a substantial intertidal zone suitable for use by geese in this area, the observation that breeding Aleutian Canada geese seldom rest on or fly low over saltwater, and the considerable distance a weathering and dispersing oil spill must traverse from the sale area to the Semidi Islands, supports the view that these geese would not be exposed to an oil spill during the breeding season.

For the aforementioned reasons, it is unlikely that there would be even minor impacts on this species from noise, disturbance, or discharges associated with oil and gas exploration, development or production activities in Cook Inlet. Certainly no significant impacts are plausible.

Potential disturbance by cleanup activities associated with any oil spill that reaches the Semidi Islands is expected to be remote from nesting geese and/or be effectively mitigated. Likewise, the combined probability (expressed as percent chance) of one or more spills greater than or equal to 1,000-barrels occurring and contacting bays east of the town of Kodiak (ERA 22), where some geese may stop during migration, is less than 0.5%.

IV.B.1.f(3)(g)2) Effects of Exploration Common to All Alternatives on the American Peregrine Falcon

Migrating peregrine falcons following the Pacific flyway from western interior nesting areas, or occasional overwintering individuals, potentially could occur seasonally in coastal areas adjacent to the proposed sale area, although such occurrence is expected to be irregular and infrequent (less than 3% of the Alaskan population). Such individuals could be disturbed on rare occasions by aircraft flights from an air-support site (for example, Kenai) to a drill rig in the sale area; avoidance responses exhibited by peregrines exposed to nearby aircraft are expected to last for a few minutes to tens of minutes per incident. Because the frequency of such support flights is likely to be only one to two per day confined to relatively restricted corridors, the probability of the intersection of their flight paths with those of an uncommon migrant or overwintering peregrine falcon is expected to be negligible and effects on the population negligible.

The rare American peregrine falcon present in the Cook Inlet sale area during migration or winter could hypothetically become oiled through contact with oiled prey or substrate in the vicinity of a spill, could hypothetically ingest oil, or could be affected indirectly through a reduction in prey, such as seabirds or waterfowl. However, the probability of contact would be reduced by their transient occurrence in the area and their habit of not typically making extensive contact with water when taking prey in this environment. Exposure of peregrines to oil would be expected to have the general effects noted for the previous species. Although reduction in prey abundance by an oil spill could result in short-term, localized reductions in food availability, it is unlikely to have a significant effect on migrant falcons. The effects of oil-spill-cleanup activities on peregrine falcons are expected to be minimal.

Because potential sources of peregrine falcon disturbance are likely to be localized in a small portion of the proposed Sale 191 area, and primarily because this species is uncommon in the Cook Inlet program area, only a very small percentage of the population potentially could be exposed to disturbance and exhibit avoidance effects for a few minutes to tens of minutes per exposure incident. As a result of their transient occurrence in the area and foraging habits, and the low probability of oil-spill occurrence and contact where peregrines might occur, they are not expected to experience oil-spill effects.

The overall effect on the peregrine falcon is expected to be minimal, with less than 3% of the population exposed to potentially adverse factors.

IV.B.1.f(3)(g)3) Effects of Exploration Common to All Alternatives on the Short-Tailed Albatross

Available evidence indicates it is unlikely that activities associated with the proposed sale in Cook Inlet would have significant negative impacts on the survival and/or the recovery of the endangered short-tailed albatross. This species does not breed within thousands of miles of the program area and is extremely rare and widely dispersed. The chance of individuals of this species being exposed to noise, disturbance, or any oil spill associated with the Proposed Action is essentially negligent for the reasons given previously. Thus, the overall effect of exposure of the short-tailed albatross to disturbance, debris, and contaminants is expected to be minimal or none.

Short-tailed albatross do no nest within thousands of miles of the Cook Inlet program area. Thus, there is no possibility of disturbance of nesting colonies of this species. Although short-tailed albatrosses formerly (pre-1900) were sighted frequently in inshore and shallow offshore waters of Alaska, sightings have been rare since this time and predominantly in the western Aleutians since 1950 (Hasegawa and De Gange, 1982). Recent sightings of this species in the eastern Gulf of Alaska region are shown on Map 15.

Aircraft probably is the only potential source of disturbance of this species; however, in view of the small proportion of the sale area likely to be traversed by support aircraft, exposure of a single albatross to such disturbance is expected to be an extremely rare event, lasting a few minutes to tens of minutes, and resulting in negligible effect. Albatrosses routinely ingest floating material such as small plastic items. Although such material is known to accumulate in the gut, its effect on adult physiology has not been determined with certainty. However, it is apparently a negative factor in chick fledging weight (Sievert, 1990); but chicks in the Japanese nesting area are not expected to be fed items originating in the sale area. If such material (for example, Styrofoam packing, wood chips) were blown off a rig or supply vessel, an albatross could encounter it; but the expected rarity of albatross occurrence and debris from the oil and gas industry in this area suggests that such encounters will not take place. Existing regulations prohibit the discharge of plastics from rigs (MARPOL, 1973).

No uniquely important habitats are expected to be vulnerable to disturbance, habitat alteration and/or contamination by oil as a result of the Proposed Action. As noted before, the Fish and Wildlife Service has concluded that, with regard to foraging areas within the United States

> …there is no information to support a conclusion that any specific marine habitat area within United States jurisdiction are uniquely important…the proposed rule also concluded that there would be no additional benefit or protection conferred through the destruction or adverse modification standard…Furthermore, there were no areas that we could identify as meeting the definition of critical habitat (65 *FR* 46644).

In a species such as the albatross, adult survival rate generally has the greatest potential to impact population growth rate (Cochrane and Starfield, 1999). However, in the short-tailed albatross, subadult survival and nesting success may currently have as large an effect on population trend as adult survival (Cochrane and Starfield, 1999).

The Fish and Wildlife Service has identified the following actions that may require ESA conference or consultation due to the potential for these actions to affect the short-tailed albatross: the National Marine Fisheries Service Fishery Management Plans, management practices at Midway Atoll, permits or authorization for oil tankering in the range of the species, and oil-spill-contingency plans. We expect that all oil and gas that could eventually be produced from projects that originate with the Proposed Action would be used for local consumption. Thus, we expect that there will be no shipment of such oil or gas via tankers. If no such tankering occurs, there would be neither an increased risk of spills nor an increase in noise and disturbance, from tankers.

Cochrane and Starfield (1999) pointed out that the impact of incidental take could pose threats to the short-tailed albatross not currently identified, if severe population reduction occurred due to some catastrophic event at the major breeding colonies or if fecundity or survival rates were significantly negatively impacted by some other factor. In the case of incidental take, there is evidence of mortality of this species. In the case here, the distribution of the short-tailed albatross makes it unlikely that it could be impacted in any way by the Proposed Action. Thus, while potential adverse effects would need to be looked at more critically if the nesting island erupted and caused decreases in reproduction or survival, we do not anticipate any such adverse effects. Based on current population status and trends, the Proposed Action is not likely to have significant adverse impacts on the short-tailed albatross.

IV.B.1.f(3)(g)4) Effects of Exploration on Steller's Eider

Steller's eiders winter in nearshore waters adjacent to, and in-shore from, portions of the program area in Cook Inlet. As detailed in the affected environment section, W. Larned has, in recent years, repeatedly observed wintering flocks of Steller's eiders within 2-3 kilometers of shore over shoals from approximately Deep Creek to approximately Bluff Point. Aggregations totaling up from about 360 to just under 2,400 individuals have been observed over these areas (for example, see Figures III.B-4 and III.B-5). Additionally, Petrula and Rosenberg (2002) observed tens to hundreds of wintering eiders in the region just south and east of Anchor Point and from the tip of the Homer Spit to approximately 5 kilometers west of Beluga Lake. In 1994, Agler et al. (1995) reported that tens to hundreds of Steller's eiders frequently occur near Homer and the Homer Spit, and that hundreds of this species were wintering along the south side of Kachemak Bay, especially between Point Bede and China Poot Bay.

Because Alaska breeding population and Russian breeding population Steller's eiders intermingle on wintering grounds and are visually indistinguishable, the Fish and Wildlife Service assumes that the percentage of birds in a given flock is equal to the approximate worldwide percentages of breeding birds in the Russian versus the Alaskan breeding populations. According to comments received from the Fish and Wildlife Service on our draft of this EIS, the Fish and Wildlife Service now assumes that 4.2% of the birds observed in wintering flocks are from the ESA-listed Alaska breeding population and the remaining 95.8% are from the nonendangered Russian breeding population (please see Comment 111-005 given in Section VII). The rationale for this percentage is apparently the same previously given by the Fish and wildlife Service for a similar assumption of 3% (although the current assumption apparently is based on more recent data). This rationale was stated by the Fish and Wildlife Service (2000:23):

> We are assuming that 3.0 percent of all Steller's eiders observed on the wintering grounds in Alaska are from the Alaska breeding population. This estimate derives from our three most recent spring migration surveys for our total population estimate (82,560 birds) (Larned 2000b), and the highest point estimate of nesting Alaskan birds (2,524 birds) (Table 2). We recognize that there is some bias in this estimate because both population estimates are negatively biased (both are conservative estimates). However, we do not know which individual estimate (wintering population or breeding population) has the greater negative bias. Thus, to some unknown extent, the biases cancel each other out.

Thus, for the Deep Creek-Bluff Point regions, numbers of potentially affected Alaska breeding population eiders would range from about 15-100 (4.2% of 360 and 2,370, respectively). In Kachemak Bay, relevant numbers of Alaska breeding population birds would range from about 2 (4.2% of 38 = 1.6) to about 12 (4.2% of 286 = 12.01). These rough estimates provide a guide for the numbers of ESA-listed Steller's eiders that potentially could be affected by noise and disturbance, and/or discharges associated with OCS oil and gas exploration in Cook Inlet. We caution against overinterpretation of these numbers for the following reasons: (1) It is not known whether the flocks of wintering Steller's eiders seen in Cook Inlet tend to be composed of individuals from the Russian breeding population and the Alaska breeding population in the same proportions as the relative numbers of breeding birds would lead one to expect. (2) The Fish and Wildlife Service has stated that there are not reliable estimates of the numbers of Steller's eiders in the breeding population in Alaska and, thus, it is difficult to derive reliable ratios on which to base a percentage. (3) It is not entirely clear that birds that breed in Alaska do not, in some years, breed in Russia. If exploration were to occur as a result of the proposed lease sale, the Steller's eider in flocks along Cook Inlet could be affected by low-flying aircraft, especially helicopters, high powered and fast motorboats, noise and movement associated with drilling rigs and well abandonment, and other forms of airborne noise and other disturbance that occurs between shore and the site of potential exploration. In-water noise from seismic surveys could also impact this species. Exploration activity that occurred in the winter along the east shore of Cook Inlet between Deep Creek and Bluff Point and near Point Bede would be most likely to result in disturbance of Steller's eider, especially if activities resulted in disturbance, alteration, or pollution of locations where the wintering birds were feeding and resting. Some exploration activities, such as seismic surveying, drilling, and well abandonment, would occur in OCS regions (at least 3 miles from shore), whereas the birds tend to be aggregated slightly closer to shore (2-3 kilometers).

These sources of potential disturbance would be longer-term, but probably less immediately disruptive than potential disturbance associated with helicopter and motorboat noise and disturbance caused by vehicles that traveled over (helicopter) or through (boats) areas near to where the birds were feeding or resting.

Helicopters probably have the greatest potential to disturb Steller's eiders. Repeated disturbance of concentrations of feeding and molting waterfowl may interfere with their ability to acquire energy needed to survive the winter, migrate, or to breed. It could cause the birds to abandon the feeding locations and move to other areas, increasing the numbers of birds feeding on the same resources.

In the proposed exploration and development scenario relevant here, an average of one to two helicopter flights per day are expected to originate from the Kenai/Nikiski area. As stated elsewhere, we presume oil industry and related project personnel would avoid flying within 1 mile of known bird or marine mammal concentration areas (when weather conditions permit) such as those identified here for wintering Steller's eiders. Such compliance would prevent frequent or excessive disturbance of these feeding flocks. However, occasional helicopter disturbance still could occur, especially if exploration activities result in helicopter transit between Nikiski or Kenai south along the coast to points such as the Anchor Point region, or across the bay to the area just off Point Bede.

Steller's eiders also could be negatively affected by well abandonment activities. As we discuss elsewhere, as part of delineation well abandonment, well casings may be cut mechanically or with explosives. Again, if such activities were just offshore of where these birds are feeding or wintering, effects could range from agitation, temporary abandonment of the feeding location, or possibly injury of individuals from explosions. However, as discussed above, safe ranges (for mammals and fish) from such explosions range from 1,000-2,000 feet, and damping effects of the seabed on the under seafloor explosion, the probability of serious impacts on Alaska breeding Steller's eider is low. However, the exact placement of wells relative to the location of the feeding shoals of the wintering aggregations would determine the impacts from well abandonment activities.

IV.B.1.f(4) Effects of Development and Production on Threatened and Endangered Species

IV.B.1.f(4)(a) Potential Pathways of Impact

Based on prior projects, noise and potential disturbance, localized habitat alteration, discharges associated with drilling, and small oil spills (defined elsewhere as all spills ranging between a tablespoon and less than 1,000 barrels) can be expected to occur if a development project resulted from the proposed lease sale.

There also are potential pathways of impact that are much less likely to occur and/or are not considered part of routine activities but that, based on data from previous development projects, have some estimable, but low, probability of occurring if a development project resulted from the proposed lease sale. This category would include large oil spills (defined elsewhere as those greater than 1,000 barrels).

If a proposed development project were to occur, the MMS would reinitiate consultation with the Fish and Wildlife Service and the National Marine Fisheries Service over the potential impacts of OCS oil and gas development in Cook Inlet on any of the ESA-protected species.

We refer the reader to the background information provided above on noise and disturbance associated with seismic surveys (which could be used before development to plan the drilling program), boat traffic, helicopters, drilling, and well abandonment, and discharges associated with exploration. These same impacts would be likely to occur during development and production. Additionally, if exploration indicated sufficient oil and/or gas resources and development ensued, additional longer-term drilling-related discharges could occur in addition to noise, disturbance, habitat alteration related to pipeline construction and noise and/or disturbance and habitat alteration related to platform construction and operation.

Small oil spills (defined as those less than 1,000 barrels) also may occur if OCS oil and gas development and production follow the proposed lease sale and associated exploration. Based on the assumptions in our oil-spill scenario (see Section IV.A.4), three (0.6%) of the small spills estimated for this project are expected to be more than 1 barrel in size. Oil spills convey a risk to any species that becomes contaminated (through inhalation, ingestion, or direct contact) with such oil. However, the number of individuals that could be affected and the severity of impacts on contacted species depends on the size of the spill, the distribution and abundance of the animals over time, the specific behavior of the species in the area of the spill, and ultimately on the severity of exposure. We discuss the potential impacts on marine mammals in more detail in Section IV.F.3.f - Effects of a Blowout on Threatened and Endangered Species. In short, exposure to crude oil through inhalation, ingestion, or in some species such as otters or birds, surface contact, can lead to a variety of effects, depending on the severity of the exposure, the state of health of the exposed individual, possibly the age of the exposed individual, and the composition of the oil. Based on the lack of observed impacts following the numerous small fuel and other petroleum spills that occur frequently in Southcentral Alaska as a result of vessel fueling, transit, and vessel sinking, the small spills projected to occur if development actually takes place are unlikely to have demonstrable impacts on marine birds or marine mammals. The impacts of the spills greater than a barrel and the potential impacts of a large spill (greater than 1,000 barrels) are discussed in the following for individual species or groups of species.

The proposed scenario assumes that both a gas pipeline and an oil pipeline will be constructed with expected landfalls for both of these pipelines to be north of Anchor Point, and probably south of Ninilchik. We assume that oil pipeline construction takes place in 2010 and gas pipeline construction takes place in 2023. We emphasize that the placement of the "Oil-Spill-Risk Analysis pipelines" are for purposes of analysis only. They were placed only to provide a more northerly and a southerly location to use as a source location in the oil-spill models. Thus, their map placement does not indicate that this is where they actually would be constructed should development occur in the proposed sale area. We estimate that construction of these 25-mile long pipelines would occur over a period of weeks. The subsea oil and gas pipelines would not be buried; because of the turbid conditions of Cook Inlet and the depth at which the pipeline would rest; the weighted pipe would become covered with silt or would be self buried. Within 2-3 miles of the tidelands, the pipeline would be buried to prevent damage from natural or human causes. Onshore, up to 75 miles of oil pipeline may need to be constructed from the landfall along the anticipated pipeline corridors to existing production facilities at Nikiski. Approximately 5 miles of onshore gas pipeline would be constructed from the landfall to tie into the anticipated gas pipeline to Nikiski. We do not expect that any breakwalls or other protective structures would be constructed associated with these pipelines. Pipeline construction could result in temporary increases in turbidity and localized mortality of invertebrates on the seafloor under the pipelines. Feeding habitat under the pipeline would be lost. Any area of feeding habitat lost under the pipeline likely would be small compared to the large areas of potential foraging habitat available to all of the threatened and endangered species in the area. Pipeline construction also could result in disturbance and temporary displacement of resident animals in the area where construction is occurring.

As detailed in Section IV.B.1.a(3)(b), discharge of muds and cuttings during production is not anticipated. Instead, new production platforms in Cook Inlet are expected to inject these drilling fluids or barge them to shore, based on current new-source guidance and Environmental Protection Agency NPDES permitting (Environmental Protection Agency, 1999, 2002).

Additionally, as detailed in Section IV.B.1.a(3)(c), discharge of produced waters is not anticipated. Instead, produced waters are expected to be injected back into underlying formations as is being done for the Osprey platform. Thus, there should be no adverse effects on threatened and endangered species within the proposed Cook Inlet sale area from discharge of produced waters.

IV.B.1.f(4)(b) Effects of Development Common to All Alternatives on Blue Whales, Sperm Whales, North Pacific Right Whales, Sei Whales, and Aleutian Canada Geese

Several species only very rarely occur in areas that could potentially be impacted by development within the Cook Inlet program area.

Available evidence indicates that blue whales and sperm whales are unlikely to inhabit the Cook Inlet program area at any time of the year. Available evidence indicates the blue whale and the sperm whale typically do not breed, calve, feed, or migrate through areas that likely would be impacted by oil and gas development within Cook Inlet. While they seasonally are present in the Gulf of Alaska, they typically are offshore and relatively rare. Sperm whales sometimes, but extremely rarely, have been observed just southwest of Shelikof Strait (see Map 12). Sperm whale females and calves are not described as inhabiting regions of the Gulf of Alaska adjacent to the Cook Inlet region. For these reasons, it is unlikely that even individual blue or sperm whales would be affected in any significant way by disturbance, discharge, or small or large spills associated with OCS oil and gas development or production activities occurring in the Cook Inlet program area. Even though sperm whales may be especially sensitive to seismic surveys (Mate et al., 1994), available information suggests that this species does not venture close enough to areas where such activity might occur to be adversely impacted by such sounds. Based on data previously presented about long-distance travel of sound in the deep sound channel, it is hypothetically possible that an individual sperm whale (or other species of whale) or group of sperm whales far off in the Gulf of Alaska could detect development sounds originating in the Barren Islands area. However, no data are available suggesting that such long-distance detection is harmful to whales.

As summarized in the section on exploration, sei whales typically do not inhabit areas within the Cook Inlet program area or areas immediately downstream of the program area. Thus, it is unlikely they would occur in areas impacted by any noise, discharge, or disturbance associated with oil and gas exploration or development within the proposed sale area. However, individual sei whales sometimes, but rarely, are observed in the southern end of the program area, in Shelikof Strait, and in waters adjacent to Kodiak Island. Thus, it is possible that an individual sei whale could be temporarily impacted by noise, disturbance, discharge, or a large spill associated with development that flowed through Shelikof Strait. It is even possible, but unlikely, that an individual sei whale could be killed due to inhalation of the toxic aromatic components of oil released in a large spill if the whale surfaced in the middle of a large spill and inhaled sufficient concentrations of toxic aromatic components. However, given the rarity of the species in areas that potentially could be affected, and by the paucity of information linking cetacean death and/or serious injury to oil exposure, the probability of any of these effects occurring is considered negligible. No population impacts are plausible for this species.

The Aleutian Canada goose does not nest within or near, or typically migrate through, the Cook Inlet program area. Because potentially disturbing activities associated with this sale would be far removed from the Semidi Islands, Aleutian Canada geese are not expected to experience any effect from such activities. This subspecies is not known to rest on saltwater during migration. A small population or subpopulation of Aleutian Canada geese nests in the Semedi Islands. It is possible that oil from a very large oil spill eventually could reach the Semidi Islands, but these geese have not been significantly impacted by previous large spills in the Cook Inlet or Prince William Sound. The combined probability (expressed as percent chance) of one or more greater than or equal to 1,000-barrel spills occurring and contacting the Semidi Islands and Kodiak Island bays is low and geese do not typically occupy habitats likely to be oiled. Thus, the effect of any oil spill is expected to be minimal. We conclude that it is highly unlikely that there would be even minor impacts on Aleutian Canada geese from the Proposed Action. No ESA "species"-level impacts are plausible.

IV.B.1.f(4)(c) Effects of Development on Other Endangered Species Act-Listed Marine Mammals

In a recent review evaluating the vulnerability of baleen whales to potential environmental degradation, Clapham and Brownell summarized that "…oil and gas development involves increased shipping traffic, seismic surveys, other noise, and the potential for catastrophic pollution events…."

IV.B.1.f(4)(c)1) Effects of Development on Fin Whales, Humpback Whales, and Beluga Whales

For fin and humpback whales, effects from noise and disturbance associated with development and production would be much the same as discussed for exploration except for potential adverse effects from large oil spills (greater than 1,000 barrels). There is a small potential for individual humpback whales and belugas to be adversely affected by well-abandonment procedures. Habitat alteration due to pipeline laying and platform construction would be localized and should not cause significant impacts to mobile species. Potential impacts of seismic activity to all three species would be expected to be lower, in part because such activity would be expected to be used in a much smaller area than during exploration. As summarized above under general effects on marine mammals, drilling noise probably does not have significant adverse impacts on these whales.

We summarize known impacts of oil spills on cetaceans in the section on the impacts of a large spill. With respect to mammals in general, ingestion of petroleum hydrocarbons can lead to subtle and progressive organ damage or to rapid death. However, the greatest threat to large cetaceans probably is from inhalation of volatile compounds present in fresh crude oil. Inhalation of volatile hydrocarbon fractions of fresh crude oil can damage the respiratory system (Hansen, 1985; Neff, 1990), cause neurological disorders or liver damage (Geraci and St. Aubin, 1982), have anesthetic effects (Neff, 1990) and, if accompanied by excessive adrenalin release, cause sudden death (Geraci, 1988). Based on evidence of observation of individuals from the AB pod of killer whales in heavy oil, and large disappearances of whales from the AB pod in the 2 years following that exposure (Dahlheim and Matkin, 1994; Harvey and Dalheim, 1994), one could conclude that whales are vulnerable if they are present within a large spill, probably due to inhalation. However, this link is circumstantial, and there is not agreement in the scientific community as to whether or not there likely was an oil-spill impact on killer whales after the *Exxon Valdez* oil spill. Similarly, gray whales with apparently abnormal behavior were observed in oil after the *Exxon Valdez* oil spill in an area where fumes from the spill were apparently very strong (J. Lentfer, cited in Harvey and Dahlheim, 1994). Subsequently large numbers of gray whale carcasses were discovered. One of three of these whales had elevated levels of polycyclic aromatic hydrocarbons in its blubber. However, again there is no other link between the observations, and Loughlin (1994) concluded it was unclear what caused the death of the gray whales.

For the reasons discussed in the previous paragraph, it is difficult to predict the impact of a large spill on either humpback whales or especially on fin whales. Based on literature on other mammals indicating severe adverse effects of inhalation of the toxic aromatic components of fresh oil, mortality of cetaceans could occur if they surfaced in large quantities of fresh oil. However, if such mortality occurred, it would be not be consistent with many, perhaps most, published findings of expected impacts of oil on cetaceans. The potential for there to be long-term sublethal (for example, reduced body condition, poorer health, or longer dependency periods), or lethal effects from large oil spill on cetaceans essentially is unknown. There are no data on cetaceans adequate to evaluate the probability of such effects.

Because of their distribution, the primary additional potential adverse effect on fin whales from development would be the effects from a large oil spill that entered Shelikof Strait. Spills that occurred lower in the inlet would be more likely to adversely impact this species because more volatiles would be present in the relatively fresher oil than if the spill occurred higher in the inlet. This species apparently inhabits the western side of the Kodiak Archipelago, Shelikof Strait and waters adjacent to the Alaska Peninsula across from Kodiak on a year-round basis. There are not data on fin whales specifically following oil spills in the region, including the *Exxon Valdez* oil spill. There is no evidence that fin whales were adversely affected by the *Exxon Valdez* oil spill, which was many times larger than the spill range we analyze here, or by the *Glacier Bay* oil spill. However, as noted in the paragraph above, based on consideration of the literature on effects of exposure to crude oil on other mammals, it is possible that fin whales could be adversely affected by a large spill that entered Shelikof Strait at any time of the year. It is even possible that fin whales could be killed if they surfaced in the midst of a large fresh oil slick and inhaled high concentrations of volatile components of crude oil. However, based on available data following both the *Exxon Valdez* oil spill and the *Glacier Bay* oil spill, it is unlikely that large numbers of fin whales would be adversely affected. There are no data or other information available that would suggest that there could be a population level effect on fin whales from any activity or event, such as an oil spill, that could result from the Proposed Action. Fin whales are widespread and relatively abundant.

During the summer and fall, humpback whales could also be negatively impacted by a large spill that occurred in the Barren Islands area or in lower Cook Inlet, or that entered Shelikof Strait. As discussed in the previous paragraphs, literature on the effects of crude oil on mammals indicate that humpback whales could be vulnerable to such a spill. There is no evidence that humpback whales were negatively impacted by the *Exxon Valdez* oil spill (von Zeigesar, Miller, and Dahlheim, 1994). However, this spill occurred prior to the period when most of humpbacks that summer in oiled areas of western Prince William Sound would be expected to be present. The whales could, however, have been exposed to oil that remained in the sound or, they could have potentially been affected by other residual or indirect effects of the spill. However, as noted, there is no evidence that they were. Even if a small number of individual humpback whales were killed, no population-level effects are likely. However, if reports to the National Marine Fisheries Service of “several hundred” humpbacks feeding in areas near the Barren Islands (See Comment

001-031in Section VII) are correct and if a large spill occurred where these whales were feeding and occurred when they are feeding, there is some possibility of a population-level effect on this species. However, available information regarding humpback abundance in the area and, more importantly, available (and attainable) information regarding the impacts of large oil spills on large cetaceans in general, and in areas such as the Barren Islands specifically, suggest that predictions about the potential magnitude of any such adverse effects to this species are highly speculative. There are no data available to MMS that definitely link a large oil spill with a significant population-level effect on large cetaceans. It is clear that there are large numbers of humpback whales on the Gulf of Alaska side of the Kodiak Archipelago. However, whales in this region are unlikely to be impacted even in the event of a large, or a very large, spill. In their Biological Opinion regarding potential effects of the proposed action on sea lions and whales, the National Marine Fisheries Service (2003:40-41 concluded that:

> Most sea lions and whales exposed to spilled oil are expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey items. Baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals may be killed as a result of exposure to freshly spilled oil. However, the combined probability of a spill occurring and also contacting sea lion or whales habitat during periods when they are present is considered to be low, and the percentage of the stock or population of these animals so affected is expected to be very small.

Beluga whales are vulnerable to the impacts of especially a nonsummer spill that occurred higher in upper areas of the proposed sale area and resulted in a plume that traveled through the lower inlet. Existing data do not indicate that they are likely to occur in Shelikof Strait. Within the lower inlet, available data indicate belugas are more abundant in nearshore areas than in offshore areas. Available information suggests that the current distribution of beluga whales has shrunk, with sightings in the lower inlet and offshore areas much less common than prior to the 1990's. For example, Speckman and Piatt (2000) reported that beluga whales commonly used bays such as Tuxedni Bay, Chinitna Bay, and probably less commonly, parts of Kachemak Bay, prior to the 1990's. If population size recovers to levels prior to that before overexploitation, it is not unlikely that population distribution will also be more similar to pre-1990's patterns. If such a change occurs, beluga whales could be vulnerable to adverse effects from a large oil spill in more areas than is apparent given available information about their current distribution. However, it is also the case, that the population significance of any given level of adverse effect would be less if the population was not depleted. Data are inadequate to confidently estimate numbers of belugas that would be vulnerable to such a spill during the winter months.

There also could be indirect effects of production and development on fin whales, humpback whales, and beluga whales due to indirect adverse effects on their prey (please see sections on the effects of the Proposed Action on essential fish habitat, commercial fisheries, and subsistence for information on potential effects on fish species in the region). However, because all of these species are relatively opportunistic in their feeding, and because there is a very large feeding range available to them, it is unlikely that such indirect effects would result in reduced health, reproduction, or survival.

Noise related to the construction of platforms could lead to local and short-term displacement of marine mammals. Beluga whales apparently do not respond negatively to producing platforms (see the discussion in Richardson et al, 1995). There is a remote possibility that well-abandonment procedures could result in harm to individual whales. If producing wells were in important feeding habitat for any of the whales (for example, in the area between the lower Kenai Peninsula and the Barren Islands), important displacement could occur. If well-abandonment procedures involving explosives occurred in this same area during the nonwinter months when humpbacks are present, there is a small possibility that humpback whales could be physically harmed by shock waves emanating from the location. However, available evidence suggests the zone in which whales could be impacted is relatively small and, thus, such impacts are viewed as unlikely to occur.

IV.B.1.f(4)(c)2) Effects of Development of Steller Sea Lions

Just as during exploration, in specific areas, particularly near the Barren Islands and Cape Douglas, there is the potential for the modification of the behavior of Steller sea lions in the water by noise and other disturbance from seismic surveys. Aircraft, particularly helicopter disturbance, could disturb sea lions on rookeries and haulouts in the Barren Islands and Cape Douglas. Such disturbance can lead to mortality. These impacts probably could be avoided through careful flight practices, particularly for helicopters in regions near these terrestrial habitats.

Impacts of a large oil spill on Steller sea lions, including discussion of data collected after the *Exxon Valdez* oil spill, are discussed more fully in the section on the effects of a very large spill. Potential effects of a large oil spill on mammals in general are discussed in Section IV.F. A large oil spill during development could have effects on any adults that inhale vapors from fresh oil, especially if they are already in a weakened physiological state. Inhalation of high concentrations of volatile components of crude oil damage the mucous membranes of the body, including those of the airways, can lead to lung congestion and, with high-enough concentrations, can cause hemorrhagic bronchopneumonia and pulmonary edema (for example, see references in Geraci and St. Aubin, 1982). As noted in Section IV.B.1.h(3)(b) on the effects of an oil spill on nonendangered marine mammals, if aspiration occurs following ingestion, doses of a few milliliters can be acutely fatal (Geraci and St. Aubin, 1982). Ingestion of crude oil can lead to diarrhea, increase passage time of food through the intestinal tract, and decrease the nutritional value of food. Skin irritation and conjunctivitis could result from prolonged exposure to oil. Such conditions can increase an individual's physiological stress and increase the likelihood of death of individuals that are highly contaminated or already weakened. Readers are referred to Sections IV.B.1.h(3)(b) and IV.B.1.f(4)(c) 2).1 for further discussion and references. Effects would be expected to be greater on the western population that the eastern population.

Because they rely on their hair for thermal protection, sea lion pups are more vulnerable to oiling and could die if significantly oiled. Thus, a spill during peak pupping season could cause pup mortality in the western population, if pups were oiled through contact with the beach or from their mothers. After the *Exxon Valdez* oil spill, harbor seal pups were observed nursing on oiled mothers, and evidence suggests they may have ingested oil from their mother's fur during nursing (Lowry, Frost, and Pitcher, 1994). Available data do not indicate such impacts on Steller sea lions after previous spills. The experience after the *Exxon Valdez* oil spill was that oil did not remain on haulouts or tend to remain on adults. However, no rookeries were in the path of fresh oil from the *Exxon Valdez* spill. Thus, it is unclear whether sea lion pup mortality is likely to occur following a large oil spill that impacted a rookery with fresh oil. Adults do not appear to be extremely susceptible to oil spills, although long-term impacts have not been well studied. The National Marine Fisheries Service (1995) previously concluded that oil and other contaminants released into the aquatic environment could adversely impact the health, survival and reproductive ability of Steller sea lions. Within the proposed Cook Inlet lease-sale area, the areas where sea lions pups would be most vulnerable to oil spills would be on rookeries; the impacts of a large marine spill are to areas around their rookeries.

The pelagic waters of Shelikof Strait, an aquatic foraging area component of Steller sea lion critical habitat could be contacted by an oil spill originating in the program area in Cook Inlet. However, the combined probabilities of a large spill actually occurring and contacting this or other Steller sea lion critical habitats are relatively low. The National Marine Fisheries Service (1995) concluded that any impact of an oil spill or other oil and gas-related activity that had an adverse effect on the production or availability of forage fish within sea lion critical habitats would have adverse impacts on this critical habitat. Carls and Rice (1989) found that the embryos of walleye pollock, a major prey item of Steller sea lions in the Gulf of Alaska, that were exposed to oil had impaired development leading to abnormalities after hatching. These effects were reached at concentrations of oil of 0.4-2.3 parts per million, levels that the National Marine Fisheries Service (1995) concluded are rarely reached in marine environments following oil spills. However, as pointed out by Carls and Rice (1989) and others (Kendall and Picquelle, 1990) spilled oil concentrates in surface layers where pollock eggs and larvae are most abundant. Carls and Rice (1989) also concluded that concentrations of hydrocarbons in seawater after a spill can reach levels capable of impeding larval swimming or causing direct mortality.

Oil spilled into Kamishak Bay could have indirect effects on Steller sea lions due to impacts on their prey. This bay is heavily used during April and May by spawning herring, and larval herring are found in Kamishak Bay before they migrate into Shelikof Strait (State of Alaska, Dept. of Fish and Game, 1992). After the *Exxon Valdez* oil spill, Biggs and Baker (1993) concluded that herring were adversely impacted by the spill. Effects reported included higher egg mortality and induced higher levels of genetic damage and physical abnormalities in oiled versus nonoiled areas.

However, even given the aforementioned, the combined probability of a large spill actually happening and contacting these areas is relatively low. Additionally, the National Marine Fisheries Service (1993) has concluded that it is unlikely the forage base in the Steller sea lion critical habitat would be sufficiently damaged to the point of adversely modifying it.

IV.B.1.f(4)(c)3) Effects of Development on the Southwest Alaska Stock of Sea Otters

The behavior of the Southwest Alaska stock of sea otters could be modified by noise and disturbance associated with exploration, development, and production. The most likely impacts could be the disturbance of sea otters that are hauled out and the displacement of females and pups that occur near regions of focused activity. These effects are expected to be extremely local and have no population-level impacts on sea otters due to their wide distribution.

Sea otters are extremely vulnerable to the impacts of oil in their habitat. This vulnerability and demonstrated mortality are discussed in the section on the impacts of a very large spill. High levels of mortality and demonstrated population-level impacts of oil on sea otters were documented after the *Exxon Valdez* oil spill. Sea otters from the designated Southwest Alaska stock in Kamishak Bay, the northwestern tip of the Kodiak Archipelago and Shuyak Island, Shelikof Strait, and portions of the Alaska Peninsula could be killed if contaminated by oil from a large spill (greater than 1,000 barrels). Estimates of total expected mortality could vary widely, depending on exactly which areas were contacted and where sea otters were at the time oil came through. The USDOI, Fish and Wildlife Service (2002) recently reported that there are an estimated 6,918 (coefficient of variation = 0.315) in Kamishak Bay, 5,893 (coefficient of variation = 0.315) in the Kodiak Archipelago, 5,212 (coefficient of variation = 0.087) along the southern shore of the Alaska Peninsula between Cape Douglas and Seal Cape, 964 (coefficient of variation = 0.087) in the Sanak, Caton, and Deer islands and the Shumagin and Pavlov Island groups), and 2,392 (coefficient of variation = 0.816) in off shore areas of the south Alaska Peninsula from False Pass to Pavlov Bay. No recent data on sea otter abundance offshore in the Shelikof Strait region are available (Burn, 2002, pers. commun.). A large spill could affect local distribution and abundance and potentially have chronic impacts in affected areas in Cook Inlet and the Kodiak Archipelago. However, the combined probabilities of a large spill actually occurring and then areas where there could be large numbers of sea otters are relatively low.

IV.B.1.f(4)(d) Effects of Development on Endangered Species Act-Listed Birds

IV.B.1.f(4)(d)1) Effects of Development on the Short-Tailed Albatross

The effects of development on the short-tailed albatross are expected to be the same as the effects of exploration. See Section IV.B.1.f(3)(g)3) - Effects of Exploration Common to All Alternatives on the Short-Tailed Albatross for a discussion of these effects.

The short-tailed albatross received the highest Oil Vulnerability Index score of all 176 bird species evaluated (King and Sanger, 1979). Thus, it is considered highly vulnerable to the impacts of oil pollution.

Oil spills can occur from the ground or collision of any fuel-powered vessel and oil is sometimes spilled during routine operations. The Fish and Wildlife Service (65 *FR* 46643) concluded that activities (including incidental mortality in longline fisheries) that may have the potential to have adverse impacts on short-tailed albatross in marine areas affect individuals rather than their habitat.

Exposure of albatrosses to oil potentially could result in effects ranging from tissue irritation to plumage fouling and death from hypothermia; intake of oil through consumption of contaminated prey, by preening, or inhalation of hydrocarbon fumes could interfere with various physiological functions and/or cause organ damage. However, short-tailed albatross are extremely rare, or possibly do not occur, in either Cook Inlet, Shelikof Strait, or other areas “downstream” of the Proposed Action area. Thus, it is unlikely that individuals of this species would be impacted by a spill originating in Cook Inlet. Individuals could be contaminated by oil, if oil from a Cook Inlet spill traveled out of Shelikof Strait and into the Gulf of Alaska along the southwestern shore of the Alaska Peninsula, or if west or southwest winds carried oil spilled in the Barren Islands area to the east or southeast. The combined probability (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels occurring and contacting any area where an albatross might occur (less than 8%) is relatively low. In the case of oil that first had to travel through

Shelikof Strait, it is probable that strong winds and currents would tend to modify and weather oil before it reached areas where short-tailed albatross are know to occur. For these reasons, we believe it is unlikely that short-tailed albatross would be exposed to an oil spill of detectable concentration. Because of their dispersed, oceanic distribution, albatross not expected to be significantly affected by oil-spill-cleanup activities occurring in Cook Inlet, Shelikof Strait, or along the south shore of the Alaska Peninsula.
No uniquely important habitats are expected to be vulnerable to disturbance, habitat alteration and/or contamination by oil as a result of the Proposed Action. As previously noted, the Fish and Wildlife Service concluded that, with regard to foraging areas within the United States:

> …there is no information to support a conclusion that any specific marine habitat area within United States jurisdiction are uniquely important…the proposed rule also concluded that there would be no additional benefit or protection conferred through the destruction or adverse modification standard…Furthermore, there were no areas that we could identify as meeting the definition of critical habitat (65 *FR* 46643:46644).

The Fish and Wildlife Service has identified the following actions that may require ESA conference or consultation due to the potential for these actions to affect the short-tailed albatross: the National Marine Fisheries Service Fishery Management Plans, management practices at Midway Atoll, permits or authorization for oil tankering in the range of the species, and oil spill contingency plans. All oil from the Proposed Action is expected to be used for local consumption. Thus, no tankering of oil that could be produced is expected.

Cochrane and Starfield (1999) pointed out that the impact of incidental take could pose threats to the short-tailed albatross not currently identified if severe population reduction occurred due to some catastrophic event at the major breeding colonies or if fecundity or survival rates were significantly negatively impacted by some other factor. The same is true for the analyses presented here. However, based on marine distribution, and current population status and trends, the Proposed Action is not likely to have significant adverse impacts on the short-tailed albatross.

Thus, the chance of individuals of this species being exposed to noise, disturbance, or any oil spill associated with the Proposed Action essentially is negligible. The overall effect of OCS oil and gas development in Cook Inlet on the short-tailed albatross is expected to be negligible or none.

IV.B.1.f(4)(d)2) Effects of Development on Steller's Eiders

There could be adverse effects from development and production on Steller's eiders in the Cook Inlet region and in areas on the Kodiak Archipelago. However, it is difficult to estimate numbers of Steller's eiders from the breeding population that could be adversely affected because of uncertainties about population size, high among-year variability in estimated abundance, and because it is unknown what proportion of Steller's eiders that overwinter in the Cook Inlet region or the Kodiak Archipelago are from the Alaska breeding population and what proportion are from the Russian breeding population.

The Fish and Wildlife Service (Larned, 2002, pers. commun.) has conducted opportunistic aerial surveys of Steller's eiders on the eastern side of Cook Inlet for the past several years while flying back to the Kenai Peninsula from areas further south. In the winters of 1997, 2001, and 2002 (January, February, or early March), he observed varying numbers (360-2,370) of Steller's eiders within 2-3 kilometers of shore over shoals in Cook Inlet between Deep Creek and the Homer Spit (for example, see data in Figures III.B-4 and III.B-5). Based on the guidance from the Fish and Wildlife Service (see Comment 111-005 in Section VII) that MMS should make the assumption that individuals from the Alaska breeding population are likely to comprise about 4.2% of Steller's eider observed on molting and wintering grounds in Alaska, the relevant numbers of Alaska breeding population eiders expected to be within these flocks would be about 15-100. Of the areas where Steller's eiders overwinter in lower Cook Inlet, the shallow, nearshore region just off of Deep Creek may represent especially high-quality (relative to other areas in the region near the Cook Inlet program area) overwintering feeding habitat for Steller's eiders, possibly due to high productivity associated with outflow from the creek (Larned, 2002, pers. commun.). During two separate surveys in 2001, large aggregations (800 versus 1,500) were observed in this area (4.2% of these aggregations would be 34 and 63). Other large aggregations have been observed just south of Ninilchik: in 1997 (650; 4.2% = ~27.3) and early March in 2001 (800; 4.2% = ~34) (Larned, unpublished data). While there is little information available about Steller's eider use of the western side of Cook Inlet, it is not likely that there are large numbers of eiders along the west side north of Tuxedni Bay (Larned, 2002, pers. commun.). Hundreds of Steller's eiders have been reported from aerial and boat bird and mammal surveys in nearshore areas of Kamishak Bay up to the Iniskin Peninsula (Arneson, 1980; Agler et al., 1995).

Alaska Department of Fish and Game biologists have conducted winter waterfowl boat-shoreline surveys and aerial surveys of offshore areas in Kachemak Bay (from Anchor Point to Point Pogibshi bounded on the west by the 151° 55'00" longitudinal line) annually since 1999 (Petrula and Rosenberg, 2002). Both shoreline areas (defined as all waters within 200 meters of land) and offshore areas were surveyed. Offshore areas were further stratified according to bathymetry. Numbers of Steller's eiders observed and estimated are presented in Table III.B-10. Several points are noteworthy. The total numbers (all offshore strata plus onshore stratum) of Steller's eiders observed among years was highly variable, ranging from a low total of 38 (4.2% = ~1.6) in 2000 to a high of 286 (4.2% = ~12) in 2001 for an offshore aerial survey only (Petrula and Rosenberg, 2002). While no very large flocks were seen, areas of concentration were from the tip of the Homer Spit to approximately 5 kilometers west of Beluga Lake to and the region just south and east of Anchor Point. In 2 years (2001 and 2002), numerous eiders were observed in the less than 20-meter substratum of the offshore stratum (Petrula and Rosenberg, 2002). Based on this and on other sources (for example, Christmas Bird Count in Service, 1998; Russ Oates, in litt., cited in 65 *FR* 13262; Agler, Kendall, and Irons, 1998) tens to hundreds of Steller's eiders frequently occur near Homer and the Homer Spit. Agler et al. (1995) also reported hundreds of Steller's eiders along the south side of Kachemak Bay, especially between China Poot Bay and Point Bede.

Parts of the Kodiak Archipelago are used by thousands of Steller's eiders as wintering habitat. The entire coastline of Kodiak Island was included in the proposed critical habitat for Steller's eider, but was removed from the final rule. Within the Kodiak Archipelago, there is considerable variation in the amount and quality of wintering habitat for Steller's eiders. The Fish and Wildlife Service concluded that this habitat heterogeneity may in part explain the lack of identified large aggregations near the archipelago (66 *FR* 8850). Dick (1977) and Forsell and Gould (1981) estimated from 1,000-2,000 wintered in the Kodiak Island area in the late 1970's. Based on an aerial shoreline surveys conducted from January 29 to February 2, 2001, of most of the eastern coastal portion of Kodiak Island and adjacent islands, including all habitats known to host significant numbers of wintering Steller's eiders, Larned and Zweifelhofer (2001) estimated and counted 5,341 and 4,196 (4.2% = ~224 and 176), respectively, Steller's eiders in the surveyed area. This total compares to an estimate of 5,349 for 1994 (Larned and Zweifelhofer, 2001). Densities of Steller's eiders in this area were low. Most eiders observed were in small flocks averaging 19 individuals with a range of 1-250 individuals observed in a "flock." The highest concentrations of eiders were observed in the southwest and west central sections of the Archipelago, including Sitkinak Strait, the passage between Sitkinak and Tugidak Islands, Chiniak Bay and Narrow Cape, particularly in extensive eelgrass shoals and lagoons (Larned and Zweifelhofer, 2001). No Steller's eiders were observed in the Afognak/Shuyak area. The Fish and Wildlife Service (65 *FR* 13272) reported there was "…consistent and extensive use of the areas that have been surveyed in the Kodiak area…."

The degree of fidelity of wintering Steller's eiders to specific regions of the Kodiak Archipelago is unknown. Extreme disparities in distribution were noted between the 2001 and the comparable 1994 survey. Far fewer eiders were observed in the Akhiok and the immediate vicinity of Kodiak and none observed in Sitkinak Island Lagoon in 2001, but many more were observed in the pass between Sitkinak and Tugidak Islands (Larned and Zweifelhofer, 2001).

Impacts on Steller's eiders from development and production could include short-term disturbance during platform and pipeline construction activities, vessel and especially helicopter traffic, discharges associated with production, and seismic surveying. Most of these potential impacts were discussed in the section on exploration, and we refer the reader to that section for discussion of potential impacts of helicopter traffic, high-speed support boats, seismic surveying, and discharges. However, with regard to the latter, we presume that drilling muds and cuttings would be reinjected into the well during any production phase rather than discharged at sea at the drilling site.

Pipeline construction could result in temporary increases in turbidity and localized mortality of invertebrates in shallow nearshore areas that are used as feeding areas by Steller's eiders. This effect could reduce available prey for an uncertain, but probably relatively short period of time (for example, one winter). Noise and disturbance associated with pipeline construction could be expected to displace Steller's eiders feeding or resting in the immediate vicinity of the construction. This effect would last only as long as the construction of the pipelines. Larned (2002, pers. commun.) consistently observed relatively high concentrations of Steller's eiders in the general area off of Deep Creek. This area may be of unusual importance for wintering Steller's eider. Pipeline construction in this area would likely have greater adverse impacts than pipeline construction at other locations along the coast. This potential adverse impact could be minimized by avoidance of pipeline placement and construction in area with consistently high Steller's eider winter habitat use.

Oil spills could impact wintering Steller's eiders if a small spill occurred near the locations of the birds, or if a large spill occurred, close to or upstream of these locations. Based on observations reported after the *Glacier Bay* oil spill, the areas affected by small spill is likely to be exceeding local. After that spill, oil concentrated in tide rips and quickly left Cook Inlet. Small spills are not expected to have any effect on the thousands of Steller's eiders wintering in the Kodiak Archipelago. Steller's eiders are concentrated in the nearshore shallow areas. Thus, only those that fly into a spill or that encounter floating oil that is traveling from OCS regions to inshore areas (as opposed to out to sea).are likely to be adversely affected. If a spill occurred in the Barren Islands areas, tracts just outside of the southeast portions of the Kachemak Bay, from points of the pipelines relatively near to the shore, or if oil entered Kamishak bay, wintering Steller's eiders could be contaminated with fresh oil, eelgrass beds in their feeding habitat could be destroyed, and prey potentially contaminated. While both direct contamination and, less likely, ingestion via prey, could result in the death of individuals, it is unlikely that there would be a significant impacts on the Alaska breeding population, due to the small percentage of the Alaska breeding population that is assumed (by Fish and Wildlife Service) to inhabit the lower Cook Inlet (including Kachemak Bay) region. However, we point out the serious difficulty in making any kind of a statement about the magnitude or significance of potential oil spill loss of Steller's eiders since the number of birds from the Alaska breeding population that inhabit the region is uncertain. Additionally, definitive estimates of the numbers of Steller's eider from any population that could be oiled are difficult because of uncertainties about the typical distribution, abundance, and behavior of the birds wintering in areas that could be oiled.

Spilled oil can have serious impacts on birds. Birds that have surface contact with oil often die within a short period of time due to loss of the insulatory characteristics of their plumage and resulting hypothermia (Hunt, 1987). Species that eat carrion can ingest oil and/or become contaminated during feeding. Species, such as harlequin ducks, that forage on species such as mussels that bioaccumulate hydrocarbons may be especially vulnerable to exposure to toxic components through their food. Ingestion can cause internal damage to organs and result in death or poor health (for example, Peakall et al., 1982). Ingestion also can lead to sublethal impacts, such as poorer body condition (Sharp, Cody, and Turner, 1996).

Small oil spills are unlikely to have significant effects on Steller's eiders from the ESA-listed population because of the low proportion of the birds in the area that are expected to be from the Alaska breeding population, and because only a small area would be expected to be affected.

Large marine oil spills are of greater concern because of the greater amount of habitat that could be oiled, the greater potential contamination of prey species, and the greater total potential for eiders from the Alaska breeding population to be exposed to oil directly or through their prey. There is the potential for large oil spills that occurred during the winter to have significant effects on Steller's eiders, but there is great uncertainty about the potential magnitude of any such effect.

IV.B.1.f(5) Onshore Pipeline Construction and Operation

Onshore, up to 75 miles of oil pipeline may need to be constructed from the landfall north of Anchor Point to the Nikiski oil and gas complex either in existent or anticipated pipeline corridors near the Sterling Highway. While an exact route cannot be established, the pipeline route would have to comply with Alaska Coastal Management Plan policies, as outlined in Sections IV.B.1.s(3)(d) and IV.B.1.s(3)(e). As construction of such a pipeline is not expected to have significant adverse effects on fish, essential fish habitat, or water quality, it is also not expected that such an onshore pipeline would have adverse effects on marine species that are listed under the ESA or that are candidates for such listing. We do not expect adverse effects on Aleutian Canada geese because the potential pipeline corridor is outside of their typical migration corridor. We do not expect adverse effects on American peregrine falcons, because available information indicates that this subspecies of peregrine does not typically breed and is not common in the potential pipeline corridor. Based on the oil spill scenario in Section IV.A.4, a 2,500-barrel onshore pipeline spill is assumed, for analysis purposes, to occur under Alternative I. If such an oil spill occurred, it is not expected to have any effect on threatened or endangered marine mammals or on Steller's eiders, because it is assumed to occur onshore some where along the 75 mile onshore pipeline and is not likely to reach the marine environment. If such a spill occurred, it is not expected to have any impact on Aleutian Canada geese or American peregrine falcons, because it is unlikely that individuals from these two subspecies would be present in the region where such a spill could occur.

IV.B.1.f(6) Large Natural Gas Release

In the unlikely event of a gas release during gas or oil production, individual birds and marine mammals in the immediate vicinity of the release could be injured or killed. However, unless a large group of threatened, endangered, or candidate marine mammals or birds was in the immediate vicinity at the time of the release, we would expect that such potential mortality would not have significant adverse population-level effects on any of these species. Such a coincidence of species aggregation and a gas release is expected to be unlikely to occur. The emission of gaseous hydrocarbons from the release would be hazardous to any animal exposed to high concentrations. However, any release is expected to be of short duration and it is likely that individual, flocks, and other groups of animals would avoid the area once the release was in progress. Gaseous hydrocarbons would be dispersed rapidly from the release site.
We expect that the likelihood is extremely small that any endangered, threatened or candidate species of marine mammal or bird would be adversely affected by a gas release. However, the likelihood varies slightly among species. It is smallest for those species (blue whales, North Pacific right whale, sperm whales, short-tailed albatross, sei whale, Aleutian Canada goose, American peregrine falcons) that typically do not occur in or near the proposed sale area. It is still extremely small, but slightly greater for the fin whale, which can occur year-round, but in relatively small numbers, in southern portions of the sale area. Humpback whales that occur seasonally in southern portions of the proposed sale area are at slightly greater risk of co-occurring with a gas blowout. Steller's eiders winter in nearshore portions of the proposed sale area. Thus, in the unlikely event that a gas blowout occurred during the winter near an aggregation, a flock or flocks of this species potentially would be at risk. However, very few individuals are expected to be from the ESA-listed American breeding population. Individuals from the eastern population of Steller sea lions can occur within the proposed sale area throughout the year. The western population of Steller's sea lions and southwest Alaska stock of sea otters breed, rear young, forage, and can live within the area year-round. Thus, of all of the threatened, endangered, and candidate species, the risk of co-occurrence with a blowout probably is greatest for these two species. Reported sightings of beluga whales are rare in most portions of the proposed lease sale area at present. However, as their population increases, they could become more common in the sale region, and their risk to a gas release would increase somewhat. Thus, there is a very small possibility that a pod of beluga whales could be killed by a gas release, primarily during the winter.

Individual fin and humpback whales conceivably would be killed by a release that occurred in lease blocks south of a line extending west from Anchor Point. It is possible, but unlikely, that a flock of Steller's eiders could be killed if they happened to be feeding or resting near, or migrating over, a platform at the time of the release. The greatest risk to this species likely would be in those lease blocks nearest to the typical nearshore (within 2-3 kilometers of shore) foraging areas of wintering eiders between Deep Creek and Bluff Point. It is possible, but unlikely, that a raft of sea otters could be killed due to a gas release, if they were in the vicinity of the platform at the time of the release. This most likely would occur if platforms were located near major haulouts, especially in the Kamishak Bay region. Rafts of sea otters can be comprised of hundreds of individuals.

If a gas release occurred within Steller sea lion critical habitat and resulted in a large number of Steller sea lion prey being killed, there could be adverse effects on that critical habitat. These would be expected to be short-term in nature, unless the release occurred at a particularly sensitive time of year and affected very large numbers of fish. It is unlikely that the eastern population of Steller's sea lions would suffer significant adverse effects, even in the event of a release. Individuals from that population stock are known to forage in the area; however, abundance of that population stock is increasing and it is unlikely that large groups of individuals would be killed. In the unlikely event that a gas release occurred on a platform located within or very near to Steller sea lion critical habitat, or in regions where large numbers of Steller sea lions from the western population aggregate (for example, near Cape Douglas or the Barren Islands), it is possible that large numbers of Steller sea lions could be killed by a release. Because the population has been in such a prolonged decline, such mortality could result in a significant adverse effect on the population.

Gas production is not expected to occur until about 2024, with pipeline construction occurring in 2022. The status of many of the threatened, endangered, and candidate species considered here could change considerably in this 20-plus year period. Thus, the potential significance of any mortality that occurred due to a gas release that occurred during production could vary from present. Given the present regulation of hunting, it is likely that the abundance of the Cook Inlet beluga whale will increase over the next 20 years. At present, the eastern population of Steller sea lions also is increasing. The likely future status of the other threatened and endangered species that potentially could be affected by a gas release is difficult to predict.

IV.B.1.f(7) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

The primary differences in the significance of effects that could occur between Sale 191 versus Sale 199 would result from changes that could occur in the status of the threatened and endangered species in the region. The species whose status is likely to change are the western population of Steller's sea lion, the Southwest Alaska stock of sea otters, Steller's eiders, and the Cook Inlet stock of beluga whales. As the distribution and abundance of a species changes, the number of individuals likely to be impacted by the Proposed Action also could (but not necessarily would) change, and the significant of effects on the population, particularly the significance of impacts on survival or reproduction, also would change.
It is not unlikely that the western population of Steller sea lions will continue to decline in the period between the two sales. At present, they are declining at more than 5% per year. Rookeries could become extinct. If this population does continue to decline, any impact on this species would become increasingly significant. Alternatively, if density-dependent factors have contributed to the decline, it is possible that Steller sea lions would begin to recover in the relatively near future. The cause of the current continued decline is uncertain. Thus, we are unwilling to speculate about likely future population trends of Steller sea lions.

The cause of the apparent sea otter decline is unknown. Thus, there is no basis on which to predict future trends of this designated population stock. Sea otters in various parts of the range of this putative stock could begin to recover, while other segments decline. Significant redistribution also could occur among areas within the range of the stock. Thus, the number and distributions of sea otters potentially affected by the Proposed Action could change significantly. As with the Steller sea lion, as abundance falls, any effect on reproduction or survival becomes increasingly significant. Conversely, if abundance within the stock begins to recover, the significance of effects decreases.

Beluga whales in Cook Inlet are expected to recover with protection from overhunting. If population increase does occur, and if distribution expands, this stock may resume higher frequency use of the central and lower portions of Cook Inlet and of areas outside of the inlet. If this occurred, beluga whale habitat use likely would have more overlap with activities associated with the Proposed Action. More beluga whales would be vulnerable to the effects of any oil spill. However, with an increase in population size, any level of impact becomes less important to the population as a whole.

IV.B.1.f(8) Effectiveness of Mitigating Measures

Mitigating measures contained in regulations applying to no-fly zones around terrestrial components of Steller sea lion critical habitat may not be sufficient to ensure that disturbance and related potential mortality does not occur as a result of helicopter traffic related to exploration and development that could occur following the proposed sales. Terrestrial critical habitats in two general locations—the Barren Islands and the Cape Douglas region—are especially vulnerable to such disturbance. Existing regulations specify that critical habitat includes an air zone of 3,000 feet above and a terrestrial zone of 3,000 feet around the base of each major rookery and major haulout in Alaska. As discussed in Section IV.B.1.f(3)(e), evidence indicates that Steller sea lions are variable in their response to aircraft and may respond to helicopter traffic at greater distances. "Withrow et al. (1985) saw 1,000+ animals stampede off a beach in response to a Bell 205 helicopter greater than 1.6 kilometers away” (Richardson et al., 1995:45). Stampeding could cause the deaths of pups and other small individuals.

Relatedly, existing mitigating measures are designed, but may not be completely effective, to avoid potential seasonal noise and disturbance effects (for example, from seismic surveys, and platform construction) on the behavior of sensitive components of humpback whale populations in the areas near the Barren Islands and Kennedy and Stevenson entrances. The MMS will be consulting with the National Marine Fisheries Service on the humpback whale, which should identify whether and what additional mitigation might be needed. Mitigating measures may not be effective in preventing all harm to at least some of the endangered, threatened, or candidate species following a large or a very large spill. Currents in Cook Inlet are extremely strong, complicating efforts to prevent the spread of spilled oil. Winter storms can cause extremely rough seas during which response would be difficult or impossible. Many types of habitats are not defensible because of their exposed location and/or currents flowing into the area. For most of the species, no effective means have been developed to move vulnerable individuals out of the path of a spill. As discussed more fully in the section on the potential effects of a very large oil spill, the ESAct-relevant species that would be most likely to be affected by a large spill, and for which known postspill mitigating measures are unlikely to be effective at preventing all potential damage, include the Southwest Alaska stock of sea otters; Steller’s eider; to a lesser extent Steller sea lions; and, to probably a much lesser extent, humpback whales, beluga whales, and fin whales. The MMS is consulting under Section 7 of the ESA with the Fish and Wildlife Service and National Marine Fisheries Service on threatened and endangered species, and may receive recommendations in the Biological Opinion regarding the need for further mitigation.

IV.B.1.g. Effects of Sale 191 on Marine and Coastal Birds

This section analyzes the potential impacts of proposed Sale 191 on marine and coastal birds. (Threatened and endangered species are analyzed in Section IV.B.1.f.) The marine and coastal birds of the proposed multiple-sale area are described in Section III.B.5. Marine and coastal birds may be vulnerable to several potentially adverse impacts from routine operations associated with exploration, development, and production, including movement and noise associated with the drilling rig, support-vessel traffic, helicopter flights, well abandonment, seismic surveys, platform construction and operation, and pipeline construction. These operations are described in Section II.B. Platform discharges are not expected to have an effect because of the high degree of dilution that would occur and the fact that bioaccumulation of associated pollutants is not expected (SAIC, 2000). However, the most serious impacts to marine and coastal birds would be from an accidental oil spill if one were to occur as a result of development activities in the proposed sale area. The oil-spill scenario for Sale 191 is described in Section IV.A.4.

IV.B.1.g(1) Conclusion

Although a large spill is unlikely, impacts on marine and coastal birds from the one large oil spill assumed for the purpose of analysis for this project could involve the loss of hundreds to possibly more than 10,000 birds, depending on the timing (summer versus winter) and size (1,500 versus 4,600 barrels) of the spill. Depending on the number of birds lost and the species involved, recovery from these losses could require 1 year to two or more generations (for the purposes of this analysis, a generation ranges from 2-4 years). Mortality associated with a natural gas release could involve a few to hundreds of individuals; these losses would be replaced within about 1 year. A limited number of birds also could be affected by helicopter overflights.

IV.B.1.g(2) Effects from Exploration

Routine operations associated with exploration that may have an effect on marine and coastal birds include movement and noise associated with the drilling rig, support-vessel traffic, helicopter flights, seismic surveys, and well abandonment. The birds that probably are most sensitive to disturbance from these types of activities are those that are actively nesting. The activities and noise associated with moving and operating the drilling rig, seismic surveys, and support vessel traffic will be conducted either well away from any nesting area (at least 3 miles) or in ports where, at most, there are only a few nesting birds. These activities also can disturb birds at sea, but the effects would be limited to the immediate vicinity of the disturbance and would be very short in duration (a few minutes to a few hours). Vessel traffic of various types is common throughout the project area, and seabirds most likely have become habituated to this activity. Seabirds are as likely to be attracted to these activities as dispersed by them.

Of the routine activities mentioned, helicopter flights probably have the greatest potential for disturbing marine and coastal birds. Although helicopter flights can have a negative impact on birds, birds' reactions to helicopters and other aircraft are complex, depending on the species involved; colony size; previous exposure levels; and the location, altitude, and number of flights (Hunt, 1985). Low-flying aircraft, especially helicopters, can disturb nesting birds, causing them to leave their nests unattended. Although the adult(s) may be absent from the nest for only a short period of time, eggs and nestlings may be lost either due to exposure or to predators, such as gulls. Birds that nest on offshore rocks and cliffs are especially vulnerable, because they might accidentally cause their eggs or young to fall from cliff ledges when they take flight due to a low-flying helicopter. Helicopters also might disturb roosting birds and birds on the water, such as cormorants, gulls, and waterfowl. Helicopter flights especially could be a problem in relatively undisturbed areas. Studies in the Bering Sea have demonstrated that repeated aircraft flights near colonies may have been a factor contributing to fewer nesting attempts and reduced reproductive success of nesting seabirds (Biderman and Drury, 1978; Hunt et al., 1978). Aircraft disturbance of waterfowl has been shown to cause lower nesting success of Pacific brants and common eiders (Gollup, Goldsberry, and Davis, 1972). Repeated air-traffic disturbance of concentrations of feeding and molting waterfowl and shorebirds on coastal lagoons and other wetlands may reduce the ability of migratory birds to acquire the energy necessary for successful migration. If such disturbance occurred frequently, migration mortality might increase, and winter survival of affected birds might be reduced. However, birds may also habituate to air traffic over time (Hunt, 1985). Thick-billed murre colonies located near an airport where they were subject to high levels of aircraft disturbance did not show a significant decrease in reproductive success compared to other thick-billed murres that nested away from the airport (Curry and Murphy, 1995).

As described in Section II.B, helicopter flights associated with the proposed lease sale are expected to originate from the Kenai-Nikiski area, probably from the municipal airport or possibly a dedicated helipad at the airport. The number of flights is expected to average about one to two per day. This analysis assumes that the oil industry and its contractors would comply with the ITL clause on Bird and Mammal Protection and avoid flying within 1 mile of seabird colonies and known bird-concentration areas when weather conditions permit them to avoid these areas (see Section II.F - Mitigating Measures). This compliance is expected to prevent excessive or frequent disturbance of seabird colonies and concentrations of waterfowl and shorebirds at nesting and feeding areas that might lead to lower productivity and nesting success. However, even with strict compliance with this ITL clause, occasional disturbances of nesting seabirds or other concentrations of birds are likely to occur from helicopter flights associated with these proposed lease sales. Impacts from helicopter flights most likely would occur along the coast in the vicinity of the Kenai-Nikiski airport. Although no large seabird colonies exist in that area (See Map 20 and USDOI, MMS, Alaska OCS Region, 1995:Graphic 1), small numbers of nesting seabirds could be disturbed. Disturbance from helicopters could result in lower productivity and nesting success, depending on the frequency and timing of the disturbances. Although the number of birds affected would be very limited, the duration of these effects could range from a few years if the birds habituate to the helicopter flights, or to the life of project, if they do not habituate.

Although bald eagles and peregrine falcons could be disturbed by aircraft flights from an air-support base such as Kenai, avoidance responses would be expected to last for a few minutes to tens of minutes per incident. Given the low expected frequency of the flights, the probability of intersection of their flight paths with that of an eagle or falcon would be very low; effects on local populations are expected to be negligible.

A gas-well blowout during exploration drilling from shallow gas could be in the range of 5-10 million cubic feet (see Section IV.A.6). If a natural gas blowout occurred with an explosion and fire, birds in the immediate vicinity would be killed. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site; thus, it is unlikely that toxic fumes would affect birds or their food sources, except those very near the blowout source. As shown on Map 20, pelagic seabird density in the sale area ranges from 0 to 100 to 500 to 1,500 per square kilometer. Therefore, bird mortality associated with a blowout could range from a few to hundreds of individuals. However, such a loss would be expected to involve several species of marine and coastal birds, with no one population suffering losses that would not be replaced within about 1 year.

Well abandonment, which is another activity associated with exploration, could harm seabirds under certain circumstances. As part of the delineation well abandonment, the casings for these wells may be cut either mechanically or with explosives. The use of explosives raises the possibility of impacts to seabirds. Although no injuries to seabirds from well abandonment with explosives have been reported, brown pelicans, cormorants, gulls, and phalaropes have been killed or injured due to other sources of underwater explosions (Fitch and Young, 1948). To be killed or injured during well abandonment with explosives, a bird would have to be submerged at the exact moment of the explosion. Although safety information is not available for birds, research on fish (Goertner, 1981) and marine mammals (Young, 1991) indicates that, for the amount of explosives used in well abandonment, a safe distance for these animals ranges from about 1,000-2,000 feet, depending on the species. However, explosive charges probably would be set several feet below the seafloor, which would dampen the effect of the blast and reduce the area in which birds could be killed or injured. Because of the water depth of the wells and the damping effect of the position of the charges below the seafloor, a bird probably would have to be submerged directly above the well to be injured during well abandonment. The seabirds that might be injured are those that forage underwater. These include loons, shearwaters, scoters, and alcids. Many of these species remain relatively close to shore and would not be affected. Gulls might be attracted to the area by the dead fish that result from underwater explosions, but gulls feed on the surface and would not be affected. Based on the damping effect of the explosions being below the sea floor and the very low probability that seabirds would be both submerged at the exact moment of an explosion and in close enough proximity to be killed or injured, no impacts to marine and coastal birds from well abandonment are expected.

Overall, the principal impacts on marine and coastal birds from exploration activities are the effects of helicopter flights (such as abandonment of roosting or foraging areas, nest abandonment, and lowered reproductive success) on those relatively few nesting or roosting individuals directly under or in close proximity (a few hundred feet) of the regular flight path. These impacts could continue for 1-2 years if birds adapt to the flights, or the life of the project if birds fail to adapt. Although a gas-well blowout during exploration drilling is unlikely, mortality associated with such an event could involve several hundred to thousands of birds; these losses would be replaced within about 1 year.

IV.B.1.g(3) Effects from Development and Production

IV.B.1.g(3)(a) Routine Operations

Routine operations associated with development and production that may have an effect on marine and coastal birds include: platform construction and operation, pipeline construction, support-vessel traffic, and helicopter flights. Small accidental oil spills also might occur as a result of development and production associated with the proposed lease sales. The seabirds that probably are most sensitive to the noise and disturbance from the types of activities listed above are those that are actively nesting. However, most of these activities, including the vast majority of pipeline construction, will be conducted either well away (at least 3 miles) from any seabird colony or in ports where, at most, there are only a few nesting birds. These activities also can disturb birds at sea, but these effects would be limited to the immediate vicinity of the disturbance and would be very short in duration (for example, a few days to a few weeks). Vessel traffic of various types is common throughout the project area, and seabirds most likely have become habituated to this activity. Seabirds are as likely to be attracted to these activities as dispersed by them.

Of the routine activities mentioned, helicopter flights probably have the greatest potential for disturbing marine and coastal birds. The location (Kenai Municipal Airport) and number (an average of 1-2 per day) of helicopter flights is expected to be the same as for exploration. The potential impacts of these flights on birds are discussed in Section IV.B.1.g(2).

The scenario for the proposed lease sales calls for the construction of both an oil and a gas pipeline. The expected landfall for these pipelines is north of Anchor Point. Over most of the 25-mile length of these pipelines, any impacts to seabirds from construction activities are expected to be limited to the immediate vicinity of the activity and would be very short in duration (i.e., a few hours to a few weeks). However, turbidity and disturbance of prey organisms in shallow nearshore waters could have temporary effects on the availability of food sources of some sea ducks. This would be limited to the relatively small number of birds that forage along the shallow, nearshore portion of the pipeline corridor and would be short (i.e., one season) in duration. The greatest potential for impacts to birds would be at the site of the pipeline landfall. Impacts due to the construction of the pipeline landfall could include the temporary displacement of feeding and roosting birds from the immediate vicinity of the construction site. Impacts to nesting birds would be more severe and could include nest desertion, nest failure, lowered reproductive success, and reduced chick growth rates. These impacts likely would affect only birds nesting near (within one-quarter mile) the construction site and would be short in nature (one season).

Depending on their size, small spills may have an effect on marine and coastal birds. Because a small amount of oil spreads out rapidly on the ocean surface to a thin sheen and the tendency for oil to break up into small patches and streamers, an oil spill has to be at least several barrels and possibly as many as 50 barrels before birds would be at risk. Based on the oil-spill scenario in Section IV.A.4, only three (0.6%) of the small spills projected for this project are expected to be greater than 1 barrel. A small number of birds (fewer than 100) could be lost as a result of the few small spills greater than 1 barrel that may occur as a result of this project.

Overall, the principal impacts on marine and coastal birds from development and production activities are the effects of helicopter flights (such as abandonment of roosting or foraging areas, nest abandonment, and lowered reproductive success) on those relatively few nesting or roosting individuals directly under or in close proximity (a few hundred feet) to the flight path. These impacts could continue for 1-2 years if birds adapt to the flights or the life of the project if birds fail to adapt. A few birds nesting within one-quarter mile of pipeline-landfall construction sites could suffer impacts during one breeding season. A limited number of birds could also be lost to small oil spills; recovery from small spills would probably require no more than 1 year.

IV.B.1.g(3)(b) Large Oil Spills

Although the risk of a large (greater than 1,000 barrels) oil spill occurring as a result of this project is low (see Section IV.A.4), for the purposes of this analysis, we assume a single large spill occurs. This single large spill, either a 1,500-barrel spill from a platform or a 4,600-barrel spill from a pipeline, can occur at any time of year.

Spilled oil may affect birds in several ways:

- direct contact with floating or beached oil,
- toxic reactions,
- damage to bird habitat,
- damage to food organisms, and
- disturbance from cleanup efforts to remove spilled oil.

Oil-related mortality is highly dependent on the life histories of the bird species involved. Birds that spend much of their time feeding or resting on the surface of the water are more vulnerable to oil spills (King and Sanger, 1979). Direct contact with even small amounts of oil can be fatal, depending on the species involved. Studies have found that exposure to as little as 3 milliliters of oil (which amounts to just less than a teaspoon) spread evenly on the wings and breast of Cassin's auklets caused severely matted plumage and was a lethal dose (Nero and Associates, 1987). The principal cause of mortality from oil contact in birds is from feather matting, which destroys the insulating properties of the feathers (Erasmus et al., 1981) and leads to death from hypothermia. Oiling also can result in a loss of buoyancy, which inhibits a bird's ability to rest or sleep on the water (Hawkes, 1961), and can diminish swimming and flying ability (Clark, 1984). Also, an oiled bird's natural tendency is to preen itself in an attempt to remove oil from the plumage. The acute toxicity of such ingested oil (crude or refined) depends on many factors, including the amount of weathering and amount of oil ingested. Birds that receive lethal doses succumb to a host of physiologic dysfunctions (for example, inflammation of the digestive tract, liver dysfunction, kidney failure, lipid pneumonia, and dehydration) (Clark, 1984). Oil that is ingested as a result of preening or eating contaminated prey also can cause abnormalities in reproductive physiology, including adverse effects on egg production (Ainley et al., 1981; Holmes, 1984; Nero and Associates, 1987). Bald eagles and peregrine falcons are particularly susceptible to oiling through contact with oiled prey. In addition, the transfer of oil from adults to eggs can result in reduced hatchability, increased incidence of deformities, and reduced growth rates in young (Patten and Patten, 1977; Stickel and Dieter, 1979). Oil contamination of brood-pouch feathers of black-legged kittiwakes and contamination of eagles as result of the *Exxon Valdez* oil spill resulted in contamination of eggs and cessation of reproduction or reduced nesting success for that year (Bowman and Schempf, 1993; Irons, 1993). Growth reduction also may be the indirect result of an oiled parent's inability to deliver sufficient food to nestlings (Trivelpiece et al., 1984).

Indirect potential effects of oil pollution include reduction, contamination, and displacement of food sources in addition to contamination of shoreline habitats. Long-term, low-level contamination of food sources and habitats theoretically could lead to chronic toxicity in birds through the accumulation of hydrocarbon residues that may adversely affect their physiology, growth, reproduction, and behavior. The contamination of intertidal prey organisms of harlequin ducks as a result of the *Exxon Valdez* oil spill apparently resulted in reproductive failure of this species in habitats contaminated by the spill for more than 3 years (Patten, 1993).

Cleanup efforts to remove spilled oil may have impacts of their own. Oil-spill-response and -cleanup activities may involve intrusion into sensitive areas. Human presence while booming off an area, cleaning oil off beaches, or attempting to capture oiled wildlife for rehabilitation near seabird colonies may cause flushing from nests or temporary abandonment. Shorebirds also are very sensitive to the effects of shoreline disturbance, which may result in the temporary loss of foraging habitat or, for local breeders, the disruption of nesting activities. Additionally, many seabirds react to disturbance by leaving their roosts or nests to go sit on the water somewhere nearby. In other words, disturbance of the colony may have the effect of flushing the birds into oiled water. This potential should be evaluated on a case-by-case basis in the event of a spill, prior to a decision to approach a roost or breeding colony. Studies of the effects of the *Exxon Valdez* oil spill suggest that noise and disturbance associated with intensive oil-spill-cleanup activities (more than 11,000 people, 1,430 vessels, and 84 aircraft) contributed to the displacement and reproductive failure of many species of nesting birds in oiled areas in Prince William Sound.

Given that a large oil spill is assumed for this analysis, at least some bird mortality will occur. However, the level of impact on birds from an oil spill depends on a variety of factors, including the type, rate, and volume of oil spilled and the weather and oceanographic conditions at the time of the spill. These parameters will determine:

- the quantity of oil that is dispersed into the water column;
- the degree of weathering, evaporation, and dispersion of the oil before it contacts a shoreline;
- the actual amount, concentration, and composition of the oil at the time of shoreline or habitat contact; and
- a measure of the toxicity of the oil.

As discussed in Section III.B.5, the marine and coastal bird community in the Cook Inlet area is complex, with the number of species, the abundance of each species, and their activity (for example, nesting, migrating, or wintering) in the project area varying with location and time of year. There also are varying degrees of vulnerability to the effects of an oil spill, with seabirds and waterfowl generally being the most sensitive. These factors all play a role in assessing the impacts of a future oil spill on birds.

One of the more important factors in accessing the impacts of an oil spill on birds is the size of the spill. As noted above, the single large spill is assumed to be either a 1,500-barrel spill from a platform or a 4,600-barrel spill from a pipeline. A perfect correlation between the size of a spill and the number of birds affected does not exist (i.e., a smaller spill at one location or time of year can sometimes affect more birds than a larger spill at a different location or time of year). Although a 4,600-barrel spill generally will have a greater impact than a 1,500-barrel spill, we have no way to estimate which size spill will occur or where and when it might occur.

Another important factor in accessing impacts on birds is the movement of the spill and the areas that might be contacted by the spill. Because of the many possible locations for an oil spill to occur in the proposed sale area and the variations in oceanographic conditions that occur from place to place and season to season in the proposed sale area, the probability of oil contacting important marine and coastal bird habitats varies widely. The probability of an oil spill contacting land or other important areas (for example, bird habitats) is determined from the Oil-Spill-Risk Analysis model. To access the impacts of an oil spill on birds, this analysis relies on conditional probabilities of oil contact (Tables A.2-1 through A.2-24), in which a spill is assumed to have occurred. Conditional probabilities are usually much higher than final probabilities, which take into account the likelihood of a spill actually occurring. Separate conditional probability tables have been developed for summer (April-September) and winter (October-March) months and for periods from 3, 10, and 30 days of the spill. As indicated in Section III.B.5, hundreds of thousands of marine and coastal birds may be present in the lower Cook Inlet during the summer months; birds generally are very widespread throughout the area during this season, and many species nest in the area. Based on the conditional probabilities of a large oil spill occurring from either a platform or a pipeline during the summer months (Tables A.2-10 through A.2-15), the greatest risk would be to the birds of the lower Cook Inlet and the northern portion of the Shelikof Strait. Important marine and coastal bird habitats in this area include Tuxedni Bay (ERA 1), Kachemak Bay (ERA's 3 and 31), Kamishak Bay (ERA's 4 and 5), Barren Islands (ERA 6), Cape Douglas (ERA 7), Shuyak Island (ERA 8), and Hallo and Kukak Bays (ERA 9). Depending on the source and location of the spill, the probability that oil will contact one of these areas after 30 days ranges from less than 0.5% to 81%. Because the probability of contact with other areas is very low (less than 0.5% to 5%), birds in these areas are not considered to be at risk.

Tables A.1-3 and A.1-5 show the estimated, discontinuous areas that could be covered by open-water oil spills of 1,500 barrels and 4,600 barrels; after 30 days, the estimated slick areas range from about 239-224 square miles (620-1,100 square kilometers). However, as indicated in these tables and in Figure IV.A-1, it also is estimated that weathering processes over that period would reduce the amount of oil remaining on the sea surface to about 30% of the initial volume of the spill. In addition, not all of the estimated area would be covered by oil—ambient wind, wave, and current conditions following a spill would tend to create a series of small slicks or patches of various thicknesses spread out over the larger area (American Petroleum Institute, 1999). Oil in various stages of weathering likely would cover hundreds of square kilometers after 30 days. Given the mean June bird densities for lower Cook Inlet that were cited in Section III.B.5.a(2), it appears that 10,000 or more birds theoretically could be contacted by a spill of this size during the summer. Of course, rapid spill containment and cleanup response would substantially reduce the surface area of the slick.

Thus, based on the large number of birds that occur in the area during the summer months and the likelihood of important bird habitats being contacted, thousands to possibly more than 10,000 marine and coastal birds could be lost as a result of the large oil spill assumed for this project. The number of birds that could be lost depends on the size of the spill (1,500 versus 4,600 barrels), the exact timing (for example, early summer versus late summer), and the movement (i.e., if the spill remains offshore, fewer birds might be lost) of the spill. In addition to direct mortality, a spill during the breeding season could result in failure to breed, reduced hatching success, reduced growth rates, reduced fledging success, and higher fledgling mortality rates, all of which would contribute to the overall impact of the spill and the time needed for recovery. Cleanup efforts could exacerbate the impacts on nesting birds.

Estimating recovery rates for marine and coastal bird populations affected by oil spills is a difficult problem. For many species the information needed to determine recovery rates from incidents causing mortality (e.g., population size, breeding rate and success, age- and sex-specific survival) is poorly known. Thus, the long-term effects (i.e., the rate of recovery) are uncertain.

The much larger *Exxon Valdez* oil spill in Prince William Sound in 1989 was estimated to have killed 100,000-300,000 birds (Piatt et al., 1990). In the 14 years since, four species are believed to have recovered within approximately two to five generations (with generation times ranging from 2-4 years), while seven other monitored species have not recovered over spans of four to seven or more generations (*Exxon Valdez* Oil Spill Trustee Council, 2002). If a spill of the size assumed for this project were to occur, recovery could require a few years to two or more generations, depending on the actual level of mortality. However, recovery of species that have declined or are declining (such as black-legged kittiwakes and common murres), whose entire population is in the area at one time (such as the rock sandpiper), or have limited capacity for population growth (such as loons and sea ducks) could take even longer.

Although birds are less abundant during the winter (Section III.B.5), tens to hundreds of thousands of birds winter in the area, especially in the Kodiak-Shelikof Strait region. Important wintering areas include Kachemak Bay (ERA 3), Shuyak Island (ERA 8), and along the northwest side of Kodiak Island (Kupreanof Strait, ERA 10). Depending on the source and location of the spill, the probability that oil will contact one of these areas after 30 days ranges from less than 0.5% to 79%. Important wintering areas along the west side and the south end of Kodiak Island are not expected to be contacted.

Based on the more limited distribution of birds during the winter compared with the summer, the lower number of birds in the area during the winter, the lower probabilities of contacting important wintering areas compared to summer, and the increased weathering estimated to occur during winter (Figure IV.A-1), hundreds to possibly thousands of birds could be lost as a result of the large oil spill assumed for this analysis. Depending on the species involved and the actual number of losses, recovery could take from 1 year to one generation.

Local reduction or contamination of food sources resulting from a large oil spill could reduce survival or reproductive success for some birds; however, many of the birds that likely would be affected by this impact probably would have died from contact with the oil itself. If the reduction or contamination of food sources persists long after the spill has dispersed or been cleaned up, impacts to local populations of birds also could persist.

Overall, the impacts on marine and coastal birds in the unlikely event of a large oil spill could involve the loss of hundreds of birds to possibly tens of thousands of birds, depending on the size (1,500 versus 4,600 barrels), timing (summer versus winter), and movement of the spill in relation to seasonal patterns of bird abundance and distribution. Depending on the number of birds involved, recovery could require a few years to two or more generations. However, recovery could be even longer for a few species.

IV.B.1.g(3)(c) Large Gas Releases

Although the risk of a large natural gas release occurring as a result of this project is low (see Section IV.A.6), for purposes of analysis, we assume that a blowout of a single well on the platform occurs. This release of 10 million cubic feet of gas for 1 day can occur at any time of year. In contrast, the rupture of a gas pipeline would result in a short-term release of gas, because a sudden decrease in gas pressure automatically would initiate procedures to close the valves that would isolate the ruptured section of the pipeline and, thus, prevent a further escape of gas.

The effects of such a large gas release and ensuing explosion and fire on marine and coastal birds would be the same as described in Section IV.B.1.g(2). Birds in the immediate vicinity would be killed. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site; thus, it is unlikely that toxic fumes would affect birds or their food sources except those very near the blowout source. As shown on Map 20, pelagic seabird density in the sale area ranges from 0 to 100 to 500 to 1,500 per square kilometer. Therefore, bird mortality associated with a blowout could range from a few to hundreds of individuals. However, such a loss would be expected to involve several species of marine and coastal birds, with no one population suffering losses that would not be replaced within about 1 year.

IV.B.1.g(4) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

We anticipate no difference in effects on coastal and marine birds from Sale 199 compared to Sale 191 other than that the potential effects may occur 2 years later.

IV.B.1.g(5) Effectiveness of Mitigating Measures

The stipulation on Orientation Program and the ITL clause on Information on Bird and Marine Mammal Protection are expected to reduce potential noise and disturbance effects of air and vessel traffic on marine and coastal birds for both Sales 191 and 199. Lessees are advised by the above ITL clause that disturbance of most birds found in or near the lease area would be unlikely if aircraft and vessels maintain a 1-mile horizontal distance and aircraft maintain at least a 1,500-foot vertical distance from known or observed wildlife concentration areas. If lessees and their contractors adhered to these recommendations, it is unlikely that any of these species would experience significant disturbance effects; however, that may not always be possible during adverse weather conditions.

IV.B.1.h. Effects of Sale 191 on Nonendangered Marine Mammals

Seven species of nonendangered marine mammals numbering in the hundreds to thousands commonly occur year-round or seasonally in a portion of or throughout the Cook Inlet Planning Area and could be exposed to some OCS exploration, development, and production activities under the proposed sales. These include the Pacific harbor seals and northern fur seals; Southcentral Alaska sea otters; killer, minke, and gray whales; and Dall's and harbor porpoises. Pollution, noise and disturbance, and alteration of habitats could adversely affect these marine mammals found within or adjacent to the proposed sales area.

To help the reader understand the following effects discussion, we define the term "regional population or population within the region" as the number of animals of a species that occur seasonally or year-round within the Cook Inlet Planning Area. A portion of a population in the region, for example, would be the number of harbor seals occurring in Kamishak Bay during the spring-summer breeding and molting periods.

IV.B.1.h(1) Conclusion

We estimate a possible loss of a small number (20-100) of harbor seas from a large oil spill. Sea otters from the Southcentral Alaska stock in Kachemak Bay and the Kenai Peninsula could be killed if contaminated by oil from an unlikely large spill. Estimates of total mortality could vary widely, depending on exactly which areas were contacted and where sea otters were at the time oil came through. No current data are available on abundance in Kachemak Bay and the lower Kenai Peninsula. A large spill could affect local distribution and abundance and potentially have chronic impacts in affected areas in Kachemak Bay. However, the combined probabilities of a large spill actually occurring (19%) and then contacting areas where there could be large numbers of sea otters would be very low (less than 5%).

A few fur seals and small numbers (perhaps 10-20) of cetaceans also could be affected by an oil spill. Total recovery from these losses likely could take place within 1 year to less than 5 years. Potential gas blowouts and gas leaks are not likely to affect nonendangered marine mammal populations. Regional populations or migrant populations of nonendangered marine mammals that occur within the Cook Inlet Planning Area likely would not be affected by Alternative I for Sale 191. For an analysis of potential effects on sea otters on the Alaska Peninsula and the Kodiak area, see Section IV.B.1.f – Endangered Species.

IV.B.1.h(2) Effects from Exploration

Effects to nonendangered marine mammals would result from routine operations or from unplanned, unlikely large oil spills. The effects of exploration would occur primarily from routine operations. No oil spills are anticipated from exploration.

IV.B.1.h(2)(a) Effects from Noise and Disturbance

Airborne or underwater noise associated with OCS activities is the main source of disturbance of harbor seals and nonendangered cetaceans.

IV.B.1.h(2)(a)1) Airborne Noise

Major sources of mobile airborne noise disturbance are low-flying aircraft and high-speed motorboats in addition to other high-frequency, high-pitched sounds. Low-flying aircraft are known to panic hauled-out harbor seals (Johnson, 1977; Murphy and Hoover, 1981). If a harbor seal rookery adjacent to the sale area were exposed to low-flying (less than 250 feet) aircraft traffic, the disturbance could result in the death or injury of some seal pups from trampling by disturbed adults. If disturbance of hauled-out seals occurred frequently during the summer molting season, the successful regrowth of skin and hair cells could be retarded, increasing physiological stress on seals during a normally stressful period. Increases in physiological stress possibly could decrease fertility and longevity of affected seals. Noise disturbance from aircraft during flyovers generally is very transient, with events not lasting more than a few seconds (Stewart, Aubrey, and Evans, 1983). Some beluga whales migrating offshore of Point Barrow in the spring were diverted by helicopter noise and presence on the ice up to 100 meters (328 feet) away (Richardson et al., 1995a). Such brief occasional disturbances are not likely to have any serious consequences for cetaceans (Richardson et al., 1991, 1995a). Stationary sources of airborne noise may include exploration and production platforms and dredging and pipeline-laying operations. These activities may disturb swimming seals and cetaceans occurring within a few kilometers of the noise sources.

IV.B.1.h(2)(a)2) Underwater Noise

Sound is more efficiently transmitted and travels at a greater velocity in water than in air. Underwater sound-propagation loss is higher in shallow water than in deep water (Greene, 1981). Bottom material, structure, and bathymetry strongly influence sound transmission. Mobile sources of industrial underwater noise include primarily support vessels, seismic boats, and aircraft; stationary sources include active dredges, drill rigs, drillships, and offshore production and processing facilities.

Underwater noise may alarm cetaceans and pinnipeds, causing them to flee the sound source. For example, Fraker, Sergeant, and Hoek (1978) reported the startled response and flight of beluga whales from barges and boats traveling through a whale-concentration area. Stewart, Aubrey, and Evans (1983) reported that beluga whales responded to outboard motor noises by immediately moving downriver away from the source. Whale exposure to playback recordings of drilling sound, however, had little effect on the movement and general activity of the whales. Reactions of cetaceans or pinnipeds to noise sources, particularly mobile sources such as marine vessels, are likely to be highly variable, depending on the animals' prior exposure to the disturbance source and their need to be in a particular habitat area where they are exposed to the noise and visual presence of the disturbance sources. For example, beluga whales foraging within the busy fishing grounds of Bristol Bay may be more tolerant of boat traffic, with shorter recovery times and shorter displacement distances from passing fishing vessels, than migrating belugas that reacted to icebreaker traffic in Lancaster Sound (located between Baffin and Devon Islands in the Canadian arctic islands), as reported by Finley and Davis (1984). The latter whales may be "naïve" with respect to vessel noise (Finley and Davis, 1984). Different populations of beluga whales might respond to icebreaker noise at varying distances (such as 5-7 kilometers away) or respond to a different icebreaker or icebreakers under different circumstances (Richardson et al., 1995a). The continued presence of various cetacean species in some areas with frequent ship traffic indicates a considerable level of tolerance to such noises (Richardson et al., 1991; Acevedo, 1991).

Because vocalizations are an important source of communication between pinnipeds mothers and pups, underwater noise may interfere with or mask reception of marine mammal communication (Perry and Renouf, 1987), or it may interfere with reception of other environmental sounds used by marine mammals for navigation (Perry and Renouf, 1987). Noise produced by outboard motors operating at high speeds may have the greatest potential for interfering with beluga whale communication and some echolocation signals (Stewart, Aubrey, and Evans, 1983), but exposure to this interference source is likely to be very transient. Low-frequency noises from drilling platforms would not mask the high-frequency echolocation signals of toothed whales (Gales, 1982). Theoretically, very noisy drilling platforms may slightly mask low-frequency whale sounds out to a range of 56 kilometers (35 miles), but the possible masking range more likely would be limited to about 4.8 kilometers (3 miles) (Gales, 1982). If the distance between communicating whales does not exceed their distance from the platforms, no appreciable interference is likely to occur (Gales, 1982). Experiments exposing captive whales to recorded drilling sounds suggest that whales can acclimate quickly to typical sound levels from oil drilling (Aubrey et al., 1984). Observations of whales near drilling platforms in Cook Inlet support this suggestion (McCarty, 1981).

Intense noise could damage the hearing of marine mammals or cause other physical or physiological harm (Geraci and St. Aubin, 1980; Hill, 1978). Probably the most intense noise that was associated with offshore industrial activity was the use of explosives in seismic-survey work (generally no longer used in seismic exploration). The sound pressure from these sources is very high and might physically injure or kill marine mammals near the explosion site. However, if spherical spreading of sound pressure is assumed, the pressure would fall below a harmful level at 2,752 meters [9,029 feet]) from the source, and lethal effects would be unlikely (Gales, 1982). Loss of hearing or auditory discomfort still may occur at greater distances from this potential noise source. Noise levels measured from various existing drilling platforms generally are well below a level of high marine mammal sensitivity for toothed cetaceans, such as beluga whales (Greene, 1986), and for pinnipeds, such as harbor seals, at a distance of 15 meters from the platform (Gales, 1982). This information suggests that drilling operations are not likely to cause any annoyance to nonendangered cetaceans and pinnipeds, except perhaps to individuals passing very close to the platforms.

Frequent and/or intense noise that causes a flight or avoidance response in marine mammals could cause displacement of animals from important habitat areas. However, the presence of several thousand beluga whales, seals, and walruses in Bristol Bay during intensive commercial-fishing activity and their exposure to noise from numerous fishing boats suggests that these species and perhaps other marine mammals can habituate to fairly high levels of human activity.

IV.B.1.h(2)(a)3) Geophysical Noise

Seismic surveys in open water produce underwater sounds with source levels that exceed those of other oil- and gas-exploration activities (Malme et al., 1989). Airgun arrays commonly used for seismic exploration in open water produce relatively brief and intermittent sounds. Depending on the acoustic environment, these seismic pulses can be detected underwater at distances of 50 kilometers or more from the source (Richardson et al., 1989).

Underwater sounds generated by seismic surveys (500 Hertz at up to 170 decibels) (Malme et al., 1989) are below the "most sensitive range" for pinnipeds (1-60 kilohertz [Richardson et al., 1991) and probably would not greatly affect harbor and fur seal activities.

Reactions of baleen whales to seismic noise have been studied directly for several species but not for the minke whale. Effects on the minke whale likely would be similar to effects on gray and humpback whales. Migrating gray whales show avoidance reactions to seismic pulses exceeding 160 decibels re 1 micropascal (μPa). Levels at which 10%, 50%, and 90% of the whales reacted were 164, 170, and 180 decibels, respectively (Malme et al., 1989). These levels were reached at 3.6, 2.5, and 1.2 kilometers (2.2, 1.6, and 0.75 miles) from the source. Humpback whales showed startle response at received sound levels of 150-169 decibels (Malme et al., 1985). Recovery of bowhead whales to typical surface-respiration-dive characteristics 30-60 minutes after disturbance by nearby seismic operations suggests that, to the extent bowhead and gray whale response to disturbance is similar, the effect of such a stimulus typically is brief. Baleen whales apparently are tolerant of seismic pulses and continue normal activities when sound levels are below 150 decibels. Subtle behavioral changes may occur on occasion at lower received levels. However, stronger avoidance reactions usually occur when sound levels reach 160-170 decibels or higher and, depending on the acoustic environment, are several kilometers from the source (Malme et al., 1989). There is a very low likelihood of the relatively few gray whales traveling through this secondary migration area intersecting with seismic vessels operating for short periods in limited areas. Consequently, few whales are expected to interact with seismic vessels and any avoidance responses should be brief, lasting an hour or less, and result in minimal effects. Seismic activities are expected in association with exploration; some minke whales are expected to locally avoid the locations of these activities at distances up to 4 kilometers. This avoidance is expected to be relatively short term, with the whales resuming normal activity patterns once testing ended.

IV.B.1.h(2)(b) Specific Effects of Noise and Disturbance from Exploration Activities

For exploratory drilling under Alternative I, one drilling rig is expected to be used each year. Platform-installation activities associated with exploration could temporarily displace (for one season) seals and perhaps some cetaceans near the platform-installation sites. Some cetaceans (such as a pod of 10-20 gray or killer whales) may, on occasion, avoid close encounters (within about 1 kilometer or 0.62 miles) with the drill platforms when noise levels are above background levels (Malme et al., 1984). However, this type of response to one exploration platform is not expected to affect the whales' migration. During the exploration period (2006-2010), there could be some brief (perhaps lasting a few minutes to less than 1 hour) displacement of seals and cetaceans because of noise and movement of aircraft (1.25-2.5 round-trip flights per day or 38-75 per month) between Kenai and the drill platform and supply-boats (0.6-1.25 round trips per day or 18-38 per month) between the drill platform and the harbor facility at Nikiski. These effects are expected to be local, within about 1.6 kilometer (1 mile) of the aircraft- and boat-traffic routes; and disturbance of harbor seals and cetaceans along these traffic routes is likely to be short-term (a few minutes to less than 1 hour). Tract-specific geophysical surveys are assumed to be conducted over 9 square miles per well for a total of 163 square kilometers (63 square miles) over 14-35 days during the exploration period (2006-2010). Cetaceans, sea otters, and seals may be temporarily displaced up to about 1 kilometer (0.62 miles) for cetaceans and a few hundred meters for seals from these seismic activities (Harris et al., 1998, as cited by Richardson, 1999, 2000). However, displaced animals likely would return to normal behavior and distribution after operations are complete.

IV.B.1.h(2)(c) Potential Effects from Gas Leaks and Blowouts

Gas from a blowout during exploration would either burn or dissipate quickly until the gas flow ceases. We expect the event will not last more than 1 day and not affect any nonendangered marine mammals.

IV.B.1.h(3) Effects of Development and Production

IV.B.1.h(3)(a) Effects from Routine Development and Production Operations

The effects of routine operations are expected to occur if the proposed leasing occurs and results in exploration, development, and production activities. Routine operations that may affect nonendangered marine mammals include disturbances from transportation, pipelines, and small spills and gas leaks.

IV.B.1.h(3)(a)1) Development and Production

During oil-field development under Alternative I (2011-2014), aircraft and supply-boat traffic to and from the one production platform would increase to as many as 2.6 helicopter round trips per day (78 per month) and up to 1.3 marine-supply-boat trips per day (40 per month). This traffic would increase the frequency of potential disturbance of harbor seals and perhaps some cetaceans along the traffic routes. Aircraft traffic (below 1,500 feet [457 meters] or within 1.6 kilometers [1 mile] of seal haulout areas) is expected to be more disturbing than boat traffic to hauled-out harbor seals. However, this analysis assumes that the oil industry and its contractors would comply with the ITL clause on Bird and Marine Mammal Protection and avoid flying within 1.6 kilometers (1mile) of known harbor seal rookeries and haulout areas when weather conditions permit them to avoid these areas (see Section II.F - Mitigating Measures). This compliance is expected to prevent excessive or frequent disturbance of harbor seals and other nonendangered marine mammals that might lead to increased stress and possible mortality of seal pups.

Some cetaceans, sea otters, and harbor seals could encounter this platform and be exposed to the noise associated with production activities. When the noise levels coming from the platform exceed background noise levels, some cetaceans may avoid close encounters (within about 1 kilometer or 0.62 miles); however, this avoidance likely would not affect the movements of individual whales or whale populations that frequent the Cook Inlet sales area. Shallow-hazard geophysical surveys for the installation of a platform (9 square miles or 23.3 square kilometers) and pipeline (11 square miles or 28.9 square kilometers) over a 4- to 10-day period temporarily could displace some cetaceans, sea otters, and seals within 1 kilometer (0.62 mile) from the activities; however, these mammals likely would return to normal behavior and distribution after installation operations are complete.

IV.B.1.h(3)(a)2) Effects of Habitat Alteration

IV.B.1.h(3)(a)2)a) Pipeline Development

The Proposed Action is assumed to include the laying of one 25-mile (40-kilometer) long subsea oil and 25-mile (40-kilometer) long gas offshore pipeline from the assumed one production platform in Cook Inlet to a landfall located north of Anchor Point. This pipeline laying likely would alter a few square miles of benthic habitat very near, or within 1 or 2 miles, of the pipelaying operation due to turbidity and removal of some prey organisms along the pipeline route. This would represent a short-term (one season) effect.

IV.B.1.h(3)(a)2)b) Oil-Terminal Development

A pipeline landfall is assumed to be located north of Anchor Point on the Kenai Peninsula and to occupy less than 50 acres (20.2 hectares) under Alternative I and the deferral alternatives, altering less than 50 acres (20.2 hectares) of coastal habitat within Cook Inlet. This development might displace a small number (probably fewer than 10) of harbor seals near the terminal site but would have no measurable effect on local populations.

IV.B.1.h(3)(b) Effects of Oil Spills

IV.B.1.h(3)(b)1) General Effects of Oil Pollution on Nonendangered Pinnipeds and Southcentral Alaska Sea Otters

This section briefly discusses the nature of effects of oil on marine mammals that commonly occur in the sales area; see OCS Reports MMS 85-0031 and MMS 92-0012 (Hansen, 1985, 1992) for a detailed discussion of the various possible direct and indirect effects of oil on marine mammals. Results of studies on the effects of the *Exxon Valdez* oil spill on sea otters, harbor seals, and on other nonendangered marine mammals were incorporated into this analysis.

IV.B.1.h(3)(b)1)a) Effects from Oil Contact

Sea otters and fur seals likely would suffer direct mortality from oiling through a reduced thermoinsulative capacity that would result in hypothermia. With the exception of northern fur seals, adults of all other pinnipeds that occur in the Cook Inlet Planning area likely would not suffer substantial loss of body heat from oil contact.

A thick coating of viscous oil could interfere with locomotion, particularly in young seal pups, perhaps leading to drowning of heavily oiled pups (St. Aubin, 1988). Oil/eye contact is known to cause severe eye irritation (i.e., conjunctivitis, swollen nictitating membranes, and corneal abrasions) in seals if exposure is prolonged (Geraci and Smith, 1976, 1977). Eye and skin irritations may increase physiological stress and contribute to the death of weakened and severely contaminated individuals (Geraci and St. Aubin, 1980). Harbor seals heavily oiled from the *Exxon Valdez* oil spill appeared to have difficulty keeping their eyes open (Lowry, Frost, and Pitcher, 1994). Conjunctivitis (eye irritation) and severe dermatitis were found in oiled seals (Spraker, Lowry, and Frost, 1994).

Pinnipeds that become oiled are likely to absorb some petroleum hydrocarbons through the skin and respiratory membranes (Engelhardt, Geraci, and Smith, 1977), and the effects of oil absorption would be similar to the effects of oil ingestion and inhalation.

IV.B.1.h(3)(b)1)b) Effects from Oil Ingestion

Oil ingestion by sea otters and pinnipeds can have pathological effects, depending on the amount ingested, the species, and the physiological state of the animal. The level of effect probably is a function of each species' physiological capacity to degrade and/or excrete petroleum hydrocarbons, the quantity and toxicity of ingested oil, and whether the ingested oil is regurgitated and aspirated into the lungs. If aspiration occurs, small doses of a few milliliters generally are acutely fatal, while relatively large quantities of oil may be tolerated if the oil is rapidly excreted from the gastrointestinal tract (Geraci and St. Aubin, 1982). If these quantities exceed the filtering ability of the kidneys (and liver) to remove toxins and the ability of the liver to detoxify hydrocarbons (Engelhardt, 1983), kidney failure may occur, with severe toxic reactions and an imbalance of body chemistry leading to the death of the animal (Oritsland et al., 1981). Chronic oil ingestion may cause degeneration of liver and kidney tissue in marine mammals such as sea otters that have thick fur (to which oil will adhere) and that exhibit intensive grooming behavior. Harbor seal pups in the area of the *Exxon Valdez* oil spill were observed nursing on oiled mothers; and cleaner areas around the nipples of nursing females suggest that pups ingested some oil from their mothers' fur while nursing (Lowry, Frost, and Pitcher, 1994). One of two oiled pups from the *Exxon Valdez* oil spill area that were brought to rehabilitation centers had hemorrhages in the stomach and small intestine (Spraker, Lowry, and Frost, 1994).

IV.B.1.h(3)(b)1)c) Effects from Oil Inhalation

The effects of oil inhalation on sea otters and pinnipeds depend on the quantity and toxicity of the vapors inhaled. Inhalation of highly concentrated petroleum vapors can cause inflammation and damage to the mucous membranes of airways, lung congestion, hemorrhagic bronchopneumonia, and pulmonary edema in severe cases (Zieserl, 1979). After extreme exposure, asphyxiation may occur (Geraci and St. Aubin, 1982). Fur-bearing species that have oil adhering to their body surfaces could be exposed to toxic fumes for prolonged periods of time. Marine mammals that exhibit extensive grooming behavior, such as sea otters, are likely to inhale oil vapors while attempting to clean their fur of the oil. Emphysema and lung congestion from the inhalation and aspiration of toxic hydrocarbons were among the primary factors in the death of sea otters contacted by the *Exxon Valdez* oil spill (Williams et al., 1990). Similar effects could be experienced by harbor seals and fur seals. Some harbor seals oiled from the *Exxon Valdez* spill had congested lungs and probably inhaled volatile-toxic hydrocarbons from the spill (Spraker, Lowry, and Frost, 1994). Histopathological analysis of dead oiled seals showed four types of brain lesions characteristic of hydrocarbon exposure (Spraker, Lowry, and Frost, 1994).

IV.B.1.h(3)(b)2) Effects on Nonendangered Cetaceans

Although the specific effects of direct oil-spill contact on cetaceans that commonly occur in Alaskan waters are uncertain, studies of hydrocarbon effects on captive dolphins by Geraci and St. Aubin (1982) provide insight into the potential effects of oil-spill contact on cetaceans in general. Subtle effects of oil and gas contact with cetacean skin were only histologically evident and, in each case, recovery occurred within a week (Geraci, 1990). These studies demonstrate the effectiveness of cetacean skin as a barrier to the noxious substances found in crude oil and gasoline. Cetacean skin impedes the penetration of volatile hydrocarbons because of the tight intercellular bridges between epidermal cells, the vitality of the superficial cells, and the extraordinary thickness of the epidermis (Geraci, 1990). The findings of the above experiments suggest that smooth-skinned cetaceans such as dolphins, porpoises, and killer whales can suffer some minor skin damage if they are confined in an area (such as an ice lead) contaminated with oil; however, such effects on the skin are likely to be short term or transient. The oil probably would be physically washed from the skin by a whale's movement and subsequently diffused, evaporated, and otherwise weathered from the skin surface within a few days.

IV.B.1.h(3)(b)2)a) Effects from Oil Ingestion

As with pinnipeds, the effects of oil ingestion on whales probably depend on the quantity and toxicity of ingested hydrocarbons and each species' physiological capacity to excrete and metabolize (degrade) petroleum hydrocarbons. If ingested oil is regurgitated and aspirated into the lungs, even small quantities can be fatal; however, cetaceans are uniquely protected from this complication by an anatomical adaptation of the larynx that greatly reduces or eliminates this possibility (Geraci and St. Aubin, 1982).

IV.B.1.h(3)(b)2)b) Effects from Oil Inhalation

Cetaceans surfacing in a fresh, unweathered oil spill would be likely to inhale some petroleum vapors (gas) that could be harmful, depending on the concentration of the vapors, the duration of exposure, and the susceptibility of the animals. Animals unable to leave the spill site would inhale toxic vapors that would irritate respiratory membranes and lead to hydrocarbon absorption into the blood stream. Such effects could threaten the health of these cetaceans and might result in the death of stressed individuals (Geraci, 1988). On the other hand, it is unlikely that cetaceans outside the immediate area of the spill (no oil contact) or cetaceans exposed to weathered or residual oils would suffer any inhalation effects, regardless of their physical condition (Geraci and St. Aubin, 1982).

Baleen Fouling: If baleen fouling in minke or gray whales occurred, a temporary reduction in feeding efficiency probably would occur (Braithwaite, 1983; Geraci, 1988). The duration of this effect would depend on the extent of the fouling, the nature of the oil, the species involved, and the behavior and activity of the whale after contact occurred. Oil fouling of the baleen probably would not have a permanent or long-term effect on filter-feeding efficiency because the baleen plates eventually would be cleared of oil by the continuous flushing of the plates with water while the whale fed. However, continuous oiling with a heavy, viscous oil of baleen plates in a whale that remained within the spill site could significantly affect the whale's feeding efficiency for several days. This exposure might affect the nutrition of that animal and adversely affect its health due to ingestion of toxic hydrocarbons.

IV.B.1.h(3)(c) Oil-Spill Avoidance

Harbor seals, other pinnipeds, and nonendangered cetaceans are not expected to initially intentionally avoid contact with an oil spill, although they might limit or avoid further contact with oil by leaving the contaminated area if they experience discomfort or stress as a result of contact with an oil slick (Hansen, 1985, 1992). However, harbor seals observed in the area of the *Exxon Valdez* oil spill continued to use oiled haulout and nursing sites and did not avoid oil on the haulouts or oil on the water (Lowry, Frost, and Pitcher, 1994). Under some circumstances, they may be attracted to the spill site if concentrations of food organisms are nearby; on the other hand, they may have little choice but to move through the spill site during migration. Gray whales were observed swimming through oil slicks from the *Exxon Valdez* oil spill during their spring migration, and 36 gray whale carcasses were found west of the oil spill on the coasts of Sitkinak and Tugidak Islands in 1989-1990 (Loughlin, 1994). However, no clear evidence exists that these whales were affected by the spill. That number of carcasses seems unusual for the two locations along the migration route, although concentrations of carcasses and strandings (up to 45 animals in one season) were reported at breeding locations (Sanchez-Pacheco, 1998).

IV.B.1.h(3)(d) Short-Term, Indirect Oil-Spill Effects

Indirect effects from an oil spill could include changes in the availability of food organisms in local habitat areas at or very near the spill sites or near coastal areas, where the oil slick comes to shore. In general, oil-spill effects on prey species and marine habitats are likely to result in the death of plankton, fish, and other food organisms that are very near the spill. However, because of the rapid evaporation, dispersion, and dilution of the oil, the number of prey organisms killed or sublethally affected by an oil spill likely would be small or insignificant compared to the number that normally are available in marine mammal feeding-habitat areas. Most marine mammal populations and their prey populations are so large and dispersed as not to be threatened by an oil-spill event, even one as large as the *Exxon Valdez* oil spill (Geraci and St. Aubin, 1990).

A possible exception could be oil-spill effects on benthic amphipods, which are an important prey of gray whales. If bottom sediments were heavily oiled in an important gray whale feeding area, the recovery of amphipods would be slow and could limit a local food source to individual whales.

IV.B.1.h(3)(e) Long-Term Oil-Spill Effects on Marine Mammals

Long-term effects of oil on benthic prey and coastal habitats could occur where high levels of hydrocarbon pollutants are incorporated into the bottom sediments of coastal areas and intertidal zones, such as saltmarsh habitats. In low wave-energy areas (if oil-spill cleanup does not occur or is ineffective), the persistence of hydrocarbon pollutants may last for several years or decades, especially in cold climates (Gundlach, Domeracki, and Thebeau, 1982; Vandermeulen and Singh, 1994). The consequences of persistent hydrocarbon pollution on marine mammals are difficult to measure or predict. All marine mammal species that occur in Alaskan waters, except sea otters and perhaps harbor seals, use a wide range of marine-habitat areas throughout their life histories. Local changes in intertidal or benthic invertebrate communities resulting from oil pollution, such as subtle changes in the abundance or distribution of some local prey organisms of harbor seals, may have measurable or detectable effects on individual harbor seals.

Although aromatic hydrocarbons generally show little tendency to biomagnify in food chains (Neff, 1990; Eisler, 1987), some potentially toxic-hydrocarbon fractions, such as naphthalene present in oil spills, can bioaccumulate somewhat within food webs through invertebrates to fish to marine mammals. These pollutants eventually accumulate in the liver and blubber tissues of marine mammals (Risebrough, 1978; Gaskin, 1982). Hydrocarbon retention might be more likely to occur in arctic environments, where hydrocarbon metabolism is slow in the pelagic prey of marine mammals (Collier, Thomas, and Malins, 1978). However, other studies suggest that marine mammals are capable of metabolizing, storing, and/or excreting low levels of hydrocarbons with little or no apparent effect on their health. Thus, we reasonably assume that marine mammals are able to cope with at least moderate levels of petroleum hydrocarbons (crude oil components) that may bioaccumulate within their tissues. Marine mammals likely have been exposed (i.e., through natural oil seeps) to moderate levels of crude oil hydrocarbons in their environment during their evolution.

IV.B.1.h(3)(e)1) Effects of Small Spills and Gas Leaks

Based on the oil-spill scenario in Section IV.A.4, a number of small spills are assumed to occur under Alternative I. These small spills are expected to have minor effects on harbor seals and other marine mammals (i.e., perhaps losses of a few individual harbor seals) due to oiling and minor, transient, local contamination of the coastal habitat would last less than 1 year. Small gas leaks are expected to be flared, and any gas that is not burned would dissipate quickly and not affect nonendangered marine mammals.

IV.B.1.h(3)(e)2) Effects of a Large Oil Spill or Large Gas Blowout

A large oil spill (greater than or equal to 1,000 barrels) is assumed to occur, based on a mean spill number of 0.16 for Alternative I for Sales 191 and 199, and an estimated 19% chance of one or more spills greater than or equal to 1,000 barrels would occur. For purposes of analysis, one 1,500-barrel platform or one 4,600-barrel pipeline spill is assumed to occur under Alternative I and under the two deferral alternatives.

If a natural gas blowout occurred, with possible explosion and fire, marine mammals in the immediate vicinity of the blowout could be killed, particularly if the explosion occurred below the water surface. Natural gas and gas condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. However, natural gas vapors and condensates would be dispersed very rapidly from the blowout site; it is not likely that these pollutants would affect any marine mammals except individuals present in the immediate vicinity of the blowout (the loss of probably fewer than 100 animals, with such losses replaced within 1 year). For any marine mammals to be exposed to high concentrations of gas vapors or condensates, the blowout would have to occur below or on the surface of the water, not from the top of the platform.

The effects of natural gas development on Pacific harbor seals; northern fur seals; Southcentral Alaska sea otters; harbor porpoises; Dall porpoises; and killer, gray, and minke whales would likely be short term (1 year or less) and local (within about 1.6 kilometers [1 mile] of blowouts, noise and disturbance, and platform- and pipeline-installation activities).

Based on the oil spill scenario in Section IV.A.4, a 2,500-barrel onshore pipeline spill is assumed to occur under Alternative I. This oil spill is not expected to have any effect on marine mammals, because it is assumed to occur onshore some where along the 75-mile onshore pipeline and is not likely to reach the marine environment.

IV.B.1.h(3)(f) Site-Specific Oil-Spill Effects

Under Alternative I for Sale 191, oil would be transported from one production platform through a 25-mile long oil and a 25-mile long gas subsea pipelines to a landfall located on the Kenai Peninsula north of Kachemak Bay.

IV.B.1.h(3)(f)1) Conditional Probability Analysis

Conditional probabilities assume that a spill occurs along a hypothetical pipeline route or within a spill launch area). Assuming a spill occurs along pipeline P1, the annual probability of contact to land segments within 30 days is highest (22%) for Tuxedni Bay (LS 35) (Table A.2-6). If a spill from P1 occurs during the summer (April-September), the probability of contact within 3 days to Kalgin Island (LS 38) is higher (4%) than if the spill occurred during the winter (2%) (Tables A.2-22 and A.2-13). Assuming a spill occurs within launch area LA1, the annual probabilities of contact to land segments within 30 days are highest (18%) for Chinitna Bay (LS 33), next highest (15%) for Iliamna Point (LS 34), and next (14%) for Tuxedni Bay (LS 35) (Table A.2-6). If the spill occurs during the winter (October-March), there is a greater risk of contact to Kamishak Bay (LS's 25-31) and Augustine Island (LS 29) than if the spill occurred during the summer (April-September) (Tables A.2-22 and A.2-13). There are harbor seal haulouts located on Kalgin Island, within Tuxedni Bay and several haulouts and other nonendangered marine mammal habitats located along the coast of Kamishak Bay and on Augustine Island (Map 16). These habitats could be contaminated, if a spill occurred within the northern portion of the sales area.

Assuming a spill occurs along P2, annual probabilities of contact to land segments within 30 days are highest, 16% for Cape Starichkof-Happy Valley (LS 45), and 13% for Chinitna Bay (LS 33). If a spill from P1 occurs during the summer (April-September) the probabilities of contact within 3 days to Cape Starichkof-Happy Valley (LS 45) and to Anchor Point-Anchor River (LS 46) are greater (17% and 7%, respectively) than during the winter (1% and 2%, respectively) (Tables A.2-13 and A.2-22). Assuming a spill occurs within LA2, the annual probabilities of contact to land segments within 30 days are highest (13%) for Chinitna Bay (LS 33), next highest, 12% for Iliamna Point (LS 34), and next, 10% for Tuxedni

Bay (LS. 35) (Table A.2-6). Spill-contact risks to Seldovia/Kachemak Bay (LS 47) and Nanwalek/Port Graham (LS 49) are low, 2% and 1%, respectively (Table A.2-6). Thus, the Southcentral Alaska stock of sea otters, harbor seal haul-out areas, and other nonendangered marine mammal habitats in Kachemak Bay and along the lower Kenai Peninsula are at low risk of being oiled under Alternative I.

Assuming a spill occurs along P3, the annual probabilities of contact to land segments within 30 days are highest at 14% for Augustine Island and are at 8% for parts of Kamishak Bay (LS's 26, 27, and 32), while the probabilities of contact to the Kenai Peninsula are lower, at 2%-4% (LS's 46, 47, and 48) (Table A.2-6). If the spill occurs during the winter (October-March), there is a greater risk of contact to southern Kamishak Bay (LS's 25-28) and Augustine Island (LS 29) than if the spill occurred during the summer (April-September) (Tables A.2-22 and A.2-13). Assuming a spill occurs along P4, the annual probabilities of contact to land segments within 30 days are highest at 17% for Spotted Glacier/Sukoi Bay (LS 25), 9% for Douglas River (LS 26 - Southern Kamishak Bay), and 9% for Fourpeaked Glacier (LS 24) (Table A.2-6). Assuming a spill occurs within LA4, the annual probabilities of contact to land segments within 30 days are highest at 14% for Augustine Island (LS 29), 12% for Douglas River (LS 26 – southern Kamishak Bay), and 10% for Spotted Glacier/Sukoi Bay (LS 25). Spill-contact risk to the Kenai Peninsula is 1% or less (LS's 41-49) (Table A.2-6). Several harbor seal haul outs and other nonendangered marine mammal habitats located long the coast of Kamishak Bay and on Augustine Island could be oiled if a spill occurred along P4 or occurred within LA4 located in lower Cook Inlet).

Assuming a spill occurs along P5, the annual probabilities of contact to land segments within 30 days are very similar to the contact probabilities for P4, with the highest contact risks to south Kamishak Bay and Augustine Island, with spill contacts on both sides of Shelikof Strait but slightly higher contact risks to the Alaska Peninsula side of the Strait (Table A.2-6). Assuming a spill occurs along P6, the annual probabilities of contact to land segments within 30 days are highest (8%-19%) for the south coast of the Alaska Peninsula (LS's 21-25). Assuming a spill occurs within LA6 or LA7, the annual probabilities of contact to land segments within 30 days are highest (7%-13% or 7%-19%, respectively) for the south coast of the Alaska Peninsula (LS's 21-25). Several harbor seal haulouts and other nonendangered marine mammal habitats located long the coast of the south side of the Alaska Peninsula could be oiled if a spill occurred in the southern portion of the proposed sales area.

Assuming a spill occurs within LA6 or LA7, the annual probability of contact to ERA 29 (southern Shelikof Strait) within 30 days is 7%-9% (Table A.2-3). This contact risk indicates that if a spill occurs in the southern portion of the proposed sale area, nonendangered marine mammal habitats south of Shelikof Strait could be contacted by the spill.

IV.B.1.h(3)(f)2) Combined Probability Analysis

Combined probabilities factor in the volume of oil assumed to be produced and the estimated spill rates for platforms, pipelines, and tankers expressed as percent chance of one or more oil spill greater than or equal to 1,000 barrels occurring and contacting environmental resource areas (important habitats of marine mammals and other wildlife). The probability (expressed as percent chance) of one or more oil spills greater than or equal to 1,000 barrels occurring under Alternative I is 19%. For purposes of analysis, this EIS assumes that a 1,500-barrel platform spill or a 4,600-barrel pipeline spill occurs. A 1,500-barrel spill is estimated to oil from 17 square kilometers (6.6 square miles) of coastline, assuming the spill occurs during winter, to 23 square kilometers (8.9 square miles) of coastline, assuming the spill occurs during summer (Table A.1-5). A 4,600-barrel spill is estimated to oil from 28 square kilometers of coastline, assuming the spill occurs during winter, to 38 kilometers (23.6 miles) of coastline, assuming the spill occurs during summer (Table A.1-5).

The Oil-Spill-Risk Analysis estimates of potential effects to nonendangered marine mammals are as follows. Attention is devoted to a spill greater than or equal to 1,000 barrels that would have a trajectory period of up to 30 days for combined annual probabilities.

The highest estimated chance of contact is 19% to land within 30 days (due to the low oil resources). Coastal habitats on the Alaska Peninsula from Tuxedni Bay south inner Kamishak Bay (ERA's 1-5 and outer Kachemak Bay (ERA 3) have a 6-2% and 4% chance, respectively, of one or more spills greater than or equal to 1,000 barrels occurring and contacting. The coastline of the Alaska Peninsula north from Cape Douglas (LS 25), including Iniskin, Iliamna, Chinitna, and Tuxedni bays (LS's 25-36) and Augustine and

Kalgin Islands (LS's 29 and 38) have a 1-2% chance of spill occurrence and contact. On the Kenai Peninsula coast, coastline habitats with some chance of spill occurrence and contact (1-2%) include Nikiski south to Anchor Point (LS's 44-46, respectively).

Assuming that a 1,500-barrel platform or a 4,600-barrel pipeline spill occurred, harbor seals and their habitats (LS's 25-36, 38, and 44-46) could be contacted by part of the spill (a 1-2% chance of occurrence and contact for one or more spills greater than or equal to 1,000 barrels) within 30 days. This contact could result in the loss of an estimated 20-100 harbor seals (based on aerial surveys of Cook Inlet and Kenai Peninsula [Loughlin, 1992; Hansen and Hubbard, 1999]). Harbor seals are likely to suffer some direct mortality from contact with the oil, resulting in inhalation of toxic petroleum vapors and absorption of petroleum hydrocarbons through the skin, leading to the death of stressed animals. Total recovery of the population likely would take from 1 year up to less than 5 years. For an analysis of potential spill effects on sea otters on the Alaska Peninsula and the Kodiak area, see Section IV.B.1.f - Effects of Sale 191 on Endangered and Threatened Species. Sea otters from the Southcentral Alaska stock in Kachemak Bay, and the Kenai Peninsula could be killed if contaminated by oil from a large spill (greater than 1,000 barrels). Estimates of total expected mortality could vary widely, depending on exactly which areas were contacted and where sea otters were at the time oil came through. No current data on abundance in Kachemak Bay and the lower Kenai Peninsula are available. A large spill could affect local distribution and abundance and potentially have chronic impacts in affected areas in Kachemak Bay. However, the combined probabilities of a large spill actually occurring and then contacting areas where there could be large numbers of sea otters would be very low.

The assumed spill has a very low chance (0-2%) of contacting lower Kenai and Kachemak Bay habitats of South-central Alaska sea otters. If a portion of the spill contacted these areas, some sea otters could be exposed to part of the spill and suffer lethal effects.

The 1,500-barrel or 4,600-barrel spill that we assume for purposes of analysis could contact a few fur seals and their secondary habitats in Shelikof Strait. These losses likely would be replaced within 1 year. Assuming that some of the oil from the spill contaminates intertidal feeding habitats of harbor seals, continued exposure of local harbor seals to petroleum contaminants may persist for a number of years. The assumed 1,500-barrel or 4,600-barrel spill has a less than 0% to 0.05% chance of contacting northern fur seal offshore habitats, such as the Portlock Banks (ERA 25), northern Albatross Bank (ERA 23), and southern Albatross Bank (ERA 20). Few northern fur seals likely would be exposed to the spill and suffer losses due to oiling of their fur and death due to hypothermia. Any losses likely would be replaced within 1 year.

Nonendangered cetaceans, such as killer whales, harbor and Dall's porpoises, and gray whales might encounter oil slicks from the 1,500-barrel or 4,600-barrel spill within the Cook Inlet Planning Area. Such an encounter could lead to the loss of some individual whales or porpoises, if the animals inhaled large amounts of toxic vapors from a fresh oil spill. Harbor porpoise densities in the Cook Inlet/Kodiak/southern Alaska Peninsula vary from 0.72-2.62 porpoises per 100 square kilometers (38.6 square miles) (Dahlheim et al., 2000). During the summer, the assumed spill would sweep over 32-56 square kilometers (12.4-21.6 square miles) within 3 days (Tables A.1-3 and 1-5). The number of porpoises exposed to the fresh spill (within 3 days) would be 100 divided by 32 and 100 divided by 56 = 0.32 and 0.56, respectively; 0.32 x 0.72 = 0.23 and 0.56 x 2.62 = 1.46 porpoises. Thus, about one to two porpoises could be exposed to the spill. Because nonendangered cetaceans occur in pods of more than two individuals, the estimated number exposed to the spill could be greater. The estimated loss could be up to perhaps 10 porpoises. Such losses are expected to be replaced within about one generation and are not expected to affect cetacean populations in the Gulf of Alaska.

Some minke whales (such as a pod of 10-20 whales) may encounter oil while filter-feeding, resulting in the oiling of their baleen. This encounter could result in a temporary reduction in feeding efficiency until the oil is flushed from their baleen plates (probably within a few days). The whales are not likely to continue to encounter oil slicks due to the rapid dispersion of the oil offshore, and the number of whales affected (probably fewer than 20) would not represent a significant part of the populations occurring in the Gulf of Alaska. Recovery from baleen oiling is expected to occur within a few days. If baleen whales ingested large amounts of oil while feeding (such as gray whales ingesting oiled benthos), mortality could occur; but the number of whales lost (an estimated 10-20) is likely to be replaced within 1 year.

IV.B.1.h(3)(g) Effects of Oil-Spill-Cleanup Activities

If a large oil spill contacted and extensively oiled coastal habitats with concentrations of harbor seals, the presence of several thousand people, hundreds of boats, and several aircraft involved in cleanup activities are expected to cause displacement of harbor seals in the oiled areas and to contribute to increased stress and reduced pup survival of harbor seals. This effect is expected to persist during cleanup operations (perhaps 1 or 2 seasons) and to affect seals within 1.6 kilometer (1 mile) or more of the activity.

IV.B.1.h(3)(h) Large Gas Releases

The effects of natural gas development on Pacific harbor and northern fur seals; Southcentral Alaska sea otters; harbor and Dall's porpoises; and killer, gray, and minke whales likely would be short term (1 year or less) and local (within about 1.6 kilometers [1 mile] of blowouts, noise and disturbance, and platform- and pipeline-installation activities).

IV.B.1.h(4) Difference in Effects from Sale 191 Compared to Lease Sale 199 Compared to Sale 199 Alternative I Activities, if Any

No difference in effects on nonendangered marine mammals are expected from Sale 199 compared to Sale 191 other than the potential effects may occur two years later.

Noise and disturbance would come from air (up to 78 helicopter-round-trip flights per month to the one platform during the height of development activities) and vessel traffic (up to 40 marine-supply-boat round trips per month), offshore pipeline laying, (25 miles or 40-kilometers), platform installation, and very local (a few acres) coastal habitat alteration at the pipeline landfall. These effects are expected to be local (within about 1.6 kilometers or 1 mile of the traffic, platforms, pipeline, and terminal activities) and short term (less than 1 hour for air- and vessel-traffic disturbance events to less than 1 year for pipeline- and platform-construction activities). Seismic activities are expected in association with exploration; some cetaceans are expected to locally avoid the locations of these activities at distances up to 4 kilometers (2.5 miles). This avoidance is expected to be relatively short term, with the whales resuming normal activity patterns once the operations have ended. Oil-spill effects on local harbor seals, Southcentral Alaska sea otters, or groups of whales and other cetaceans present within the sale area during the hypothetical 1,500-barrel platform or the 4,600-barrel pipeline oil spill are estimated to include the following: the loss of an estimated 20-100 harbor seals, small numbers (perhaps 10-30 animals) of the Southcentral Alaska sea otters, a few fur seals, and small numbers (10-20) of cetaceans. Total recovery from these losses likely would take place within 1 year to less than 5 years. Regional populations or migrant populations of nonendangered marine mammals occurring within Cook Inlet likely would not be affected by the Proposed Action. For an analysis of potential effects on sea otters on the Alaska Peninsula and the Kodiak area, see Section IV.B.1.f(2) - Endangered and Threatened Species.

IV.B.1.h(5) Effectiveness of Mitigating Measures

The stipulation on Orientation Program and the ITL clause on Bird and Marine Mammal Protection are expected to reduce potential noise and disturbance effects of air and vessel traffic on nonendangered marine mammals under both Sales 191 and 199. The Orientation Program is expected to inform oil-company workers and company contractors of the sensitivity of harbor seals to noise and disturbance from air and vessel traffic and to make the workers (and aircraft pilots) aware of the ITL clause and the recommended measures to be taken to avoid disturbing seal haulout areas and rookeries.

This analysis assumes that the oil industry and its contractors would comply with the ITL clause on Bird and Marine Mammal Protection and avoid flying within 1.6 kilometers (1 mile) of seal rookeries, haulout sites, and other known marine mammal-concentration areas, when weather conditions permitted them to avoid these areas. This compliance is expected to prevent excessive or frequent disturbance of seal, sea otter, and cetacean concentrations. However, some disturbance of hauled-out and feeding seals, sea otters, and cetaceans is expected to occur when (1) weather conditions prevent aircraft from flying at or above the recommended 1,500 feet or within 1.6 kilometers (1 mile) from these concentrations; (2) aircraft may fly low over concentrations of seals or otters during takeoffs and landings; and (3) boats may disturb seals, sea otters, or cetaceans concentrated near the drill platform and shore base facility. These effects are expected to be short term and local and not to affect nonendangered marine mammal populations.

The ITL clause on Sensitive Areas to Be Considered in the Oil-Spill-Contingency Plans may provide some protection, at least in theory, for nonendangered marine mammal sensitive habitats that are listed in the ITL clause (such as Kachemak and Kamishak bays, Kalgin Island, and Cape Douglas). The lessees are informed that these areas should be protected in the event of an oil spill. However, it is unlikely that oil-spill-protection and -cleanup measures would prevent a large spill from contacting these marine and coastal bird habitats, if wind and ocean currents are driving the spill into these areas. The use of dispersant may reduce the toxic effects of a spill, but the dispersant itself could foul the fur of harbor seals that would be contacted on the water by the dispersant and may result in seal mortality from absorption of toxic chemicals through the skin.

The stipulation on Protection of Biological Resources primarily concerns protection of benthic habitats that may be buried or covered by drill-platform installation. The amount of benthic habitats (probability 1 square kilometer or 0.386 square mile) is not expected to be of consequence to most nonendangered marine mammal populations, with the possible exception of gray whales that may feed in the area; thus, this stipulation is not expected to provide much protection to nonendangered marine mammals. Other stipulations that are part of the Proposal and other proposed mitigating measures (see Section II.F) are not intended to provide any additional protection for nonendangered marine mammals or to reduce potential adverse effects.

If these mitigating measures were not part of Alternative I, the effects on nonendangered marine mammals are expected to be about the same as with the measures enforced. This is because the measures that provide protection for nonendangered marine mammals, primarily the ITL clause on Bird and Marine Mammal Protection, are still likely to be complied with by the lessees because of the Marine Mammal Protection Act, which requires lessees to have a permit to conduct activities that may harass or take marine mammals in order to limit and avoid excessive harassment or takings of nonendangered marine mammals.

IV.B.1.i. Effects of Sale 191 on Terrestrial Mammals

Cook Inlet coastal area river otters, brown bears, and Sitka black-tailed deer are the species of terrestrial mammals most likely to be affected to some degree by oil and gas exploration and development associated with the Proposed Action. Primary effects are expected to come from potential oil spills and lesser effects from noise and disturbance associated with air and vessel traffic. The result of studies on the effects of the *Exxon Valdez* oil spill on river otters were incorporated into this analysis.

IV.B.1.i(1) Conclusion

The overall effect on terrestrial mammals is expected to include the loss of small numbers of river otters (an estimated 10-30), brown bears (an estimated 10), and Sitka black-tailed deer (fewer than 20) directly killed or affected by the assumed 1,500- or 4,600-barrel-oil spill, assuming contact (conditional probability greater than or equal to 1% to contact specific land segments) to coastline habitats. Total recovery of terrestrial mammal habitats is estimated to take more than 1 to perhaps 3 years for river otters and, perhaps, brown bears and 1 year for deer. Regional populations of brown bears, river otters, Sitka black-tailed deer, and other terrestrial mammals likely would not be affected by the oil spill or by the exploration and development activities. Offshore gas blowouts and gas leaks are not likely to have any effect on terrestrial mammals. The gas is likely to disperse before reaching coastal habitats of terrestrial mammals.

IV.B.1.i(2) Effects from Exploration

The following effects on terrestrial mammals are estimated to be the same for all alternatives and result from routine operations or from unplanned, unlikely large oil spills.

The effects of exploration would occur primarily from routine operations. No oil spills are anticipated from exploration, small gas leaks would be flared, and any gas that is not burned would dissipate quickly and not affect terrestrial mammals.

For exploratory drilling from Sales 191 and 199, one drilling unit is expected to be used each year. There could be some brief (perhaps a few minutes to less than 1 hour) displacement of brown bears, moose, and other terrestrial mammals on the Kenai Peninsula because of noise and movement of aircraft traffic (60 helicopter flights per month) between the Kenai/Nikiski area and the drill platform located in the lower Cook Inlet area. There also could be some brief displacement of these animals because of marine-vessel-support traffic (18-38 supply boats per month) between the drill platforms and a marine-support facility in the Kenai area.

These effects are expected to be local, within about 1 mile of the aircraft- and boat-traffic routes and have no lasting effect on bears or other terrestrial mammals.

IV.B.1.i(3) Effects of Development and Production

IV.B.1.i(3)(a) Effects from Routine Operations

The effects of routine operations are expected to occur if the proposed leasing occurs and results in exploration, development, and production activities. Routine operations may affect terrestrial mammals through disturbances from transportation, pipelines, and small spills. Small gas leaks would be flared; and any gas that is not burned would dissipate quickly and not affect terrestrial mammals.

IV.B.1.i(3)(b) Effects of Development Noise and Disturbance

During oil and gas development, aircraft and supply-boat traffic to and from the one production platform is estimated to increase from 1.25-2.5 per day during the 4 years of exploration to 1.3-2.6 helicopter trips per day during the 3 years of development; the marine-supply-boat traffic to and from the platform is estimated to increase from 0.6-1.25 per day during the 4 years of exploration to 0.666-1.3 vessel trips per day (20-40 per month) during the 3 years of development. When nearshore, this traffic is expected to increase the frequency or potential disturbance of bears and other terrestrial mammals along the traffic routes. However, the disturbance events are expected to be brief (a few minutes to less than 1 hour), and the displacement of bears and other terrestrial mammals is expected to last for less than 1 hour, with no lasting effect on the individual animals. The number of animals displaced is expected to be few (such as 1-3 bears). Onshore, the construction of up to 75 miles of oil pipeline may be needed from the landfall along the anticipated pipeline corridors to existing production facilities at Nikiski. Approximately 5 miles of onshore gas pipeline would be constructed from the landfall to tie into the anticipated gas pipeline to Nikiski. This construction activity could temporarily displace some terrestrial mammals along the onshore pipeline route.

IV.B.1.i(3)(c) Effects from Oil Spills

In general, the effects of potential oil spills on terrestrial mammals would result from oil contamination of individual mammals, contamination of coastal habitats, and contamination of some local food sources.

IV.B.1.i(3)(c)1) Effects on Sitka Black-Tailed Deer

Sitka black-tailed deer depend primarily on sedges, kelp, and tidal vegetation along coastal beaches during severe winters. If an oil spill contacts these coastal areas, this vegetation could be heavily contaminated or destroyed by the spill. If kelp and other tidal vegetation became heavily oiled from a spill occurring during a severe winter along the western coast of Kodiak and Afognak Islands, Sitka black-tailed deer wintering in the area could suffer the loss of winter forage and ingestion of contaminated vegetation. This ingestion could result in mortality if the oil is fresh. Toxicity studies of crude-oil ingestion in cattle (Rowe, Dollahite, and Camp, 1973) indicate that anorexia (with significant weight loss) and aspiration pneumonia leading to death are possible consequences of oil ingestion in deer. Although the fur of deer might become oiled by a spill, deer are not expected to suffer any loss of thermal insulation; however, some hydrocarbons could be absorbed through the animals' skin. The combination of oil ingestion and hydrocarbon absorption and loss of winter forage could increase winter mortality among Sitka black-tailed deer on Kodiak and Afognak Islands.

The examination of deer tissues from animals collected in Prince William Sound after the *Exxon Valdez* oil spill indicated no apparent evidence of oil ingestion: examination of deer carcasses collected up to about 1 year after the spill did not show any oil-related mortality (Lewis and Calkins, 1991). However, if the spill had occurred during the middle of the winter when deer forage heavily on kelp and other tidal vegetation, ingestion of oiled vegetation by deer might have occurred, and the spill could have contributed to some winter mortality in the deer population.

IV.B.1.i(3)(c)2) Effects on Brown Bears

Brown bears depend on coastal streams, beaches, mudflats, and river mouths during the summer and fall for catching salmon, clams, and other food sources. If an oil spill contaminates beaches and tidal flats along the Alaska Peninsula coast, some brown bears are likely to ingest contaminated food sources such as clams and carrion (from dead oiled birds and sea otters). Such ingestion could result in the loss of at least a few brown bears.

An oiling experiment on captive polar bears indicated that if a bear's fur becomes contaminated with oil and the bear ingests a considerable amount of oil while grooming, kidney failure and other complications could lead to the death of contaminated bears or possible death of bears that consume contaminated food (Oritsland et al., 1981). Brown bears on the Shelikof Strait coast of Katmai National Park (an area contacted by the *Exxon Valdez* oil spill) were observed with oil on their fur and were consuming oiled carcasses (Lewis and Sellers, 1991). A study of the exposure of Katmai National Park (Katmai Bay area) brown bears to the *Exxon Valdez* spill through analysis of fecal samples indicated that some bears had consumed oil or were exposed to oil and that one young bear that died had high concentrations of aromatic hydrocarbons in its bile and might have died from oil ingestion (Lewis and Sellers, 1991). By the time the *Exxon Valdez* oil spill reached Shelikof Strait and contacted the coast of the Katmai Bay area, most of the oil was highly weathered and probably had low levels of highly toxic aromatic hydrocarbons. If a large oil spill occurred within Cook Inlet or Shelikof Strait, the oil that might contact habitats frequently used by bears would be fresher and more toxic than the weathered oil from the *Exxon Valdez* oil spill that had contacted the area in 1989. An oil spill that originates in lower Cook Inlet/Shelikof Strait and contacts high-use habitats of brown bears during the spring would be expected to have a more serious effect on brown bears than the *Exxon Valdez* oil spill.

IV.B.1.i(3)(c)3) Effects on Coastal River Otters

River otters use coastal beaches and tidal flats and nearshore marine waters for feeding and movements. Oil contamination of these habitats could contaminate locally important food sources and expose these furbearers to direct oiling and oil ingestion through grooming and consumption of contaminated prey and oiled carrion. River otters probably are the terrestrial mammal species most vulnerable to direct oiling because they spend considerable time feeding in coastal marine waters in addition to foraging along the shoreline. River otters probably are similar to sea otters in sensitivity to oil due to loss of thermal insulation, because their fur-pelage plays an important role in body insulation as it does in sea otters (Tarasoff, 1974). River otters also are very likely to ingest oil that has contaminated their fur. River otters were reported to have died from oil ingestion after contact with an oil spill (Baker et al., 1981). Autopsy information on river otters that died in association with the *Exxon Valdez* oil spill indicated that the animals probably died from oil ingestion and oil-vapor inhalation through grooming their fur and through ingestion of contaminated prey, such as mussels and clams (Faro, Bowyer, and Testa, 1991). Evidence of tissue damage and hemolytic anemia (indicated by significantly elevated hepatoglobin levels) and significant reduction in body mass, reduced diet diversity, avoidance of preferred habitats, and increased home ranges were evidence of chronic and delayed oil exposure (oil-ingestion-inhalation) effects from the *Exxon Valdez* oil spill on river otters in Prince William Sound (Bowyer et al., 1993; Bowyer, Testa, and Faro, 1994; Duffy et al., 1993; Faro, Bowyer, and Testa, 1991). A study of captive river otters fed up to 500 parts per million of oil in their diet compared to control animals fed the same diet without oil confirmed the physiological and behavioral effects observed in river otters affected by the *Exxon Valdez* oil spill (Ben-David, Williams, and Ormseth, 2000). Decreased hemoglobin levels in oil-fed otters resulted in increased oxygen consumption, and fewer dives were observed when the otters were chasing fish. This finding supports the hypothesis that river otters exposed to the oil spill were sublethally affected by the spill through ingestion of oil while grooming and through consumption of oil-contaminated prey. This physiological effect resulted in reduced diving ability and associated reduction in diversity of prey consumed and reduced home-range use (Ben-David, Williams, and Ormseth, 2000; Ben-David, Duffy, and Bowyer, 2001).

IV.B.1.i(3)(d) Effects of Small Spills

Based on the oil-spill scenario in Section IV.A.4, a number of small spills are assumed to occur under Alternative I. These minor oil spills are expected to have a minor effect on river otters and other terrestrial mammals. Perhaps a few individual river otters and brown bears could be exposed to the oil spills and be adversely affected, and minor-transient local coastal habitat contamination would last less than 1 year.

IV.B.1.i(3)(e) Effects of a Large Oil Spill or Gas Blowout

A large oil spill (greater than or equal to 1,000 barrels) has an estimated 19% chance of occurrence based on a mean number of 0.16 spills for Alternative I for Sales 191 and 199. For purposes of analysis, one oil spill of 1,500 barrels or one spill of 4,600 barrels is assumed to occur under Alternative I and under the two deferral alternatives.

Offshore gas blowouts and gas leaks are not likely to have any effect on terrestrial mammals. The gas is likely to disperse before reaching coastal habitats of terrestrial mammals.

Based on the oil-spill scenario in Section IV.A.4, a 2,500-barrel onshore pipeline spill is assumed to occur under Alternative I. This oil spill is expected to have a minor effect on river otters, brown bears, and other terrestrial mammals along the onshore pipeline route. Perhaps a few individual river otters and brown bears could be exposed to the oil spill and be adversely affected, and minor-transient local habitat contamination would more than 1 to several years, depending spill-cleanup efforts.

IV.B.1.i(3)(f) Site-Specific Effects of Oil Spills

Oil and gas development is assumed to occur in the lower Cook Inlet area, with the oil transported from one production platform by one 25-mile (40-kilometer) long oil and one 25-mile (40-kilometer) long gas subsea pipeline to a landfall facility located north of Anchor Point.

The results of the Oil-Spill-Risk Analysis regarding potential effects on terrestrial mammals and their habitats are as follows. Attention is devoted to oil spills greater than or equal to 1,000 barrels, which have a trajectory period of up to 30 days during the summer (April-September).

IV.B.1.i(3)(f)1) Conditional Probability Spill Analysis

Conditional probabilities assume that an oil spill occurs along a hypothetical pipeline route or within a spill block area. Assuming an oil spill occurs along P1, the annual probability of contact to land segments within 30 days is for Tuxedni Bay (LS 35) (Table A.2-6). If an oil spill from P1 occurs during the summer (April-September), contact within 3 days to Kalgin Island (LS 38) is higher (4%) than if the oil spill occurred during the winter (2%) (Tables A.2-22 and A.2-13). Assuming a spill occurs within launch block L1, the annual probabilities of contact to land segments within 30 days are highest: 18% for Chinitna Bay (LS 33); 15% for Iliamna Point (LS 34); and 14% for Tuxedni Bay (LS 35) (Table A.2-6). If the oil spill occurs during the winter (October-March), there is a greater risk of contact to Kamishak Bay (LS's 25-31) and Augustine Island (LS 29) than if the oil spill occurred during the summer (April-September) (Tables A.2-22 and A.2-13). Terrestrial mammal habitats are located on Kalgin Island within Tuxedni Bay, and brown bear coastal and stream habitats are located along the coast of Kamishak Bay and on Augustine Island (Map 17). These habitats could be contaminated if an oil spill occurred within the northern portion of the proposed sales area.

Assuming an oil spill occurs along pipeline P2, the annual probability of contact to land segments within 30 days is highest, 16% for Cape Starichkof-Happy Valley (LS 45) and 13% for Chinitna Bay (LS 33). If an oil spill from P1 occurs during the summer (April-September), contact within 3 days to Cape Starichkof-Happy Valley (LS 45), and to Anchor Point-Anchor River (LS 46) is greater (17% and 7%, respectively) than during the winter (1% and 2%, respectively) (Tables A.2-13, A.2-22). Assuming an oil spill occurs within launch block L2, the annual probabilities of contact to land segments within 30 days are highest: 13% for Chinitna Bay (LS 33); 12% for Iliamna Point (LS 34); and 10% for Tuxedni Bay (LS 35) (Table A.2-6). Oil-spill-contact risks to Seldovia-Kachemak Bay (LS 47) and Nanwalek-Port Graham (LS 49) are low, 2% and 1%, respectively (Table A.2-6). Thus, terrestrial mammal habitats in Kachemak Bay and along the lower Kenai Peninsula are at low risk of being contaminated by oil under Alternative I.

Assuming an oil spill occurs along pipeline P3, the annual probabilities of contact to land segments within 30 days is highest: 14% for Augustine Island and 8% for parts of Kamishak Bay (LS's 26, 27, and 32); while the probabilities of contact to the Kenai Peninsula are lower: 2-4% (LS's 46, 47, and 48) (Table A.2-6). If the oil spill occurs during the winter (October-March), there is a greater risk of contact to southern Kamishak Bay (LS's 25-28) and Augustine Island (LS 29) than if the oil spill occurred during the summer (April-September) (Tables A.2-22, A.2-13). Assuming an oil spill occurs along pipeline P4, the annual probabilities of contact to land segments within 30 days is highest: 17% for Spotted Glacier-Sukoi Bay (LS 25); 9% for Douglas River (LS 26-Southern Kamishak Bay); and 9% for Fourpeaked Glacier (LS 24) (Table A.2-6). Assuming a spill occurs within launch block L4, the annual probabilities of contact to land segments within 30 days are highest: 14% for Augustine Island (LS 29); 12% for Douglas River (LS 26-Southern Kamishak Bay); and 10% for Spotted Glacier-Sukoi Bay (LS 25). Oil-spill-contact risk to the Kenai Peninsula is 1% or less (LS's 41-49) (Table A.2-6). Several brown bear habitats located along the coast of Kamishak Bay could be contaminated by oil if an oil spill occurred along pipeline route P4 or occurred within launch block L4 located in lower Cook Inlet.

Assuming an oil spill occurs along pipeline P5, the annual probabilities of contact to land segments within 30 days are very similar to the contact probabilities for P4, with the highest contact risks to South Kamishak Bay and Augustine Island and with oil-spill contacts on both sides of Shelikof Strait, but slightly higher contact risks to the Alaska Peninsula side of the Strait (Table A.2-6). Assuming a spill occurs along pipeline P6, the annual probabilities of contact to land segments within 30 days are highest: 8-19% chance of contact for the southern coast of the Alaska Peninsula (LS's 21-25). Assuming an oil spill occurs within launch block L6 or L7, the annual probabilities of contact to land segments within 30 days are highest: a 7-13% or 7-19% chance of contact, respectively, for the south coast of the Alaska Peninsula (LS's 21-25). Several brown bear habitats located along the coast of the southern side of the Alaska Peninsula could be contaminated by oil, if an oil spill occurred in the southern portion of the sales area.

Assuming an oil spill occurs within LA6 or LA7, the annual probability of contact to ERA 29 (southern Shelikof Strait) within 30 days is 7-9% (Table A.2-3). This oil-spill-contact risk indicates that if an oil spill occurs in the southern portion of the sales area, some terrestrial mammal habitats south of Shelikof Strait could be contacted by the spill.

IV.B.1.i(3)(f)2) Combined Probability Analysis

The probability (expressed as percent chance) of one or more oil spills greater than or equal to 1,000 barrels occurring under Alternative I is 19%. For purposes of analysis, this EIS assumes that a 1,500-barrel platform oil spill or a 4,600-barrel pipeline oil spill occurs. A 1,500-barrel spill is estimated to oil 17 square kilometers (6.6 square miles) of coastline, assuming the oil spill occurs during winter, to 23 square kilometers (8.9 square miles) of coastline oiled, assuming the oil spill occurs during summer (Table A.1-3). A 4,600-barrel spill is estimated to oil 28 square kilometers (17.4 miles) of coastline, assuming the spill occurs during winter, to 38 kilometers (23.6 miles) of coastline oiled, assuming the oil spill occurs during summer (Table A.1-5).

The highest estimated chance of contact is 19% to land within 30 days (due to the low oil resources). Coastal habitats on the Alaska Peninsula from Tuxedni Bay south to inner Kamishak Bay (ERA's 1-5 and outer Kachemak Bay (ERA 3) have a 6-2% and a 4% chance of one or more oil spills greater than or equal to 1,000 barrels occurring and being contacted, respectively. The coastline of the Alaska Peninsula north from Cape Douglas (LS 25), including Iniskin, Iliamna, Chinitna, and Tuxedni bays (LS's 25-36) and Augustine and Kalgin islands (LS's 29 and 38) have a 1-2% chance of oil spill occurrence and contact. On the Kenai Peninsula coast, coastline habitats with some chance of oil spill occurrence and contact (1-2%) include Nikiski south to Anchor Point (LS's 44 and 46, respectively (Figure IV.A-1).

The oil spill is most likely to contact coastal habitats on the western shore of lower Cook Inlet (the Chinitna or Tuxedni Bay areas) and in the Kachemak Bay or the Ninilchik areas (Figure IV.A-1). Brown bears, river otters, and other terrestrial mammals inhabiting these areas likely would have some limited contact with the oil spill.

IV.B.1.i(3)(f)2)a) Effects on River Otters

River otters could suffer some direct losses due to contact with a portion of the assumed 1,500-barrel platform or 4,600-barrel pipeline spill. A number of river otters (perhaps 10) could be directly killed by the spill. However, more river otters (an estimated 21-30 otters based on 0.8 otters per kilometer of coastline [Bowyer et al., 1993] times 17-38 square kilometers (6.6-14.7 square miles) of oiled coastline from the assumed 1,500-barrel or 4,600-barrel oil spill [Tables A.1-3 and A.1-5]) could be exposed to the oil spill. River otters frequenting coastal habitats that become oiled are expected to ingest oiled mussels and other oiled intertidal prey organisms. This exposure is expected to result in changes in habitat use and reduced diversity in food-source availability, leading to decreased body growth and fitness in coastal otters that are continually exposed to contaminated prey. These effects are expected to persist for more than 1 year (perhaps 3 years).

IV.B.1.i(3)(f)2)b) Effects on Brown Bears

Brown bears are expected to be affected primarily through ingestion of oil-contaminated prey (such as mussels and clams) and carrion. A small number of bears (an estimated 10) could be killed or sublethally affected as a result of contact (through ingestion of oiled carcasses) with a portion of the oil spill (an estimated 30% of the spill remaining during the summer after 30 days and an estimated 5.4-5.8% of the spill remaining after 30 days during winter in open water habitats; Figure IV.A-1). Brown bears could be affected by ingesting oil by grooming oiled fur or ingesting heavily oiled prey. Assuming that important brown bear spring-concentration areas in Chinitna Bay and Ursus Cove, or summer feeding areas such as Katmai Bay, were oiled by the spill, some portion of the brown bear population (perhaps 10 bears) that use this habitat during the summer could ingest oiled clams or other intertidal prey organisms from contaminated intertidal sediments (mudflats and saltmarshes) for a number of years after the spill. This ingestion is expected to have sublethal effects on the fitness of some bears and might contribute to a decline in survival of exposed bears. However, neither these sublethal effects, nor the direct loss of bears to the spill (an estimated 10 bears), are expected to have population-level effects on brown bears in the Cook Inlet Planning Area.

IV.B.1.i(3)(f)2)c) Effects on Sitka Black-Tailed Deer

Sitka black-tailed deer are not expected to be greatly affected by oil exploration and development, because industrial activities and a portion of the assumed 1,500-barrel or 4,600-barrel oil spill are not expected to contact this species' winter habitats on the northwest coasts of Kodiak and Afognak Islands. Conditional probabilities of one or more spills greater than or equal to 1,000 barrels occurring and contacting these habitats are as follows. During winter, there is a 2-6% chance of an assumed pipeline (P6) or platform (L7) oil spill contacting Afognak and Shuyak Islands Sitka black-tailed deer habitat within 30 days, which is similar to the chance (2-7%) of a summer spill contacting these habitats (Appendix A, Tables A.2-6 and A. 2-15., LS's 81-85). Deer that ingest unweathered, highly toxic oil that adheres to kelp or other vegetation from a portion of either the 1,500-barrel platform or 4,600-barrel pipeline spill (estimate of 5.4-5.8% of the oil remaining after 30 days during winter in open-water habitats) could suffer lethal effects. Deer that ingest weathered oil on plants could experience reduced fitness and survival. However, the number of deer killed or seriously affected by the oil (an estimated 20 or fewer) likely would be replaced by population recruitment within 1 year.

Noise and disturbance effects from air (60 helicopter flights per month) and marine-vessel traffic (18-38 boat trips per month during exploration and 20-40 boat trips per month during development) are expected to have short-term (a few minutes to less than 1 hour) displacement effects on brown bears, moose, and other terrestrial mammals within about 1 mile of the traffic routes when near shore. The assumed 1,500-barrel platform or 4,600-barrel pipeline oil spill is expected to result in the loss of a small number of river otters (an estimated 10-30), a small number of brown bears (an estimated 10-30), and some Sitka black-tailed deer (an estimated 100 or fewer). Recovery could take more than 1 year (perhaps 3 years) for river otter and brown bear intertidal habitats and prey and 1 year for deer. Regional populations of river otters, brown bears, Sitka black-tailed deer, and other terrestrial mammals likely would not be affected by the oil spill or by the overall effect of exploration and development activities associated with Alternative I for Sales 191 and 199.

IV.B.1.i(3)(g) Large Gas Releases

Offshore gas blowouts and gas leaks are not likely to have any effect on terrestrial mammals. The gas is likely to disperse before reaching coastal habitats of terrestrial mammals.

IV.B.1.i(4) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

If the scenario takes place exclusively as the result of Sale 199, the activities would be undertaken 2 years later (starting in 2006) but would not differ in location, duration, or magnitude. The actions would cause the same effects described above, only 2 years later.

IV.B.1.i(5) Effectiveness of Mitigating Measures

The ITL No. 1 - Information on Bird and Mammal Protection is expected to reduce noise and disturbance effects of air and vessel traffic on terrestrial mammals occurring along the coast of the proposed sales area indirectly through this measure's recommended air- and vessel-traffic distances to avoid disturbance nonendangered marine mammals that generally use many of the same coastal habitats as terrestrial mammals. This measure is expected to prevent frequent disturbance to terrestrial mammals from air and vessel traffic along the coast of the proposed sales area. However, on occasion, air traffic is expected to disturb individual brown bears, or females and cubs, and other terrestrial mammals. This effect is expected to be short term and local and is not expected to affect terrestrial mammal populations. Other stipulations that are part of the Proposal and other proposed mitigating measures (see Section II.F) do not provide any additional protection for terrestrial mammals nor reduce potential adverse effects.

IV.B.1.j. Effects of Sale 191 on the Economy

IV.B.1.j(1) Conclusion

The Proposed Action would generate increases in property taxes for the Kenai Peninsula Borough that would average about 6% above the level of Borough revenues without Alternative I. Alternative I would generate revenue increases to the State of Alaska of less than 0.01% above the level without Alternative I. Total employment and personal income would not increase over the 2000 baseline for the Kenai Peninsula Borough and the rest of Alaska for each of the three major phases of OCS activity: exploration, development, and production. If an unlikely large oil spill occurred, we estimate employment to be 60-190 cleanup workers for 6 months in the first year, declining to zero by the third year following the spill. We anticipate no effects from the release of 5-10 million cubic feet of natural gas during exploration or 10 million cubic feet during development.

IV.B.1.j(2) Effects from Exploration

Alternative I exploration would generate no revenues to the Kenai Peninsula Borough or to the State government. Alternative I exploration would generate total employment and personal income of workers resident in the Kenai Peninsula Borough as shown in Table IV.B-19. There would be no change in employment and personal income over the 1999 baseline for the Kenai Peninsula Borough or the rest of Alaska, as explained in greater detail in Section IV.B.1.j(3). In addition, drilling-unit crews primarily would be workers from outside the State. In general, these workers from outside the State would travel to and from the proposed sales area by jet or turboprop aircraft using the airport at Kenai. These crews would transfer to site by helicopter. The Exploration and Development Scenario for Alternative I indicates that exploration activity would take place in 2006-2010. We anticipate no effects from the release of 5-10 million cubic feet of natural gas during exploration. In the event of a gas blowout, we assume the gas would disperse into the air without burning. The amount of work necessary to repair the gas well after a blowout would be minimal.

IV.B.1.j(3) Effects from Development and Production

Alternative I development and production would generate economic activity primarily in property taxes, employment, and personal income. The economic effects would be in the Kenai Peninsula Borough. The Exploration and Development Scenario, described in Appendix B, is the basis for analysis of potential economic effects in this section. The reader should refer to this section for a description of timing of OCS activity including infrastructure of wells, rigs, platforms, and pipelines. The activities and construction and operation of infrastructure described in the exploration and development scenario would generate the economic activity. The Exploration and Development Scenario indicates that:

- the most likely support base for exploration would be Kenai/Nikiski or alternate locations in Cook Inlet (Anchorage, Homer);
- subsea pipelines would connect the offshore field to onshore lines running north on the Kenai Peninsula to existing processing and distribution centers in Kenai;
- the preferred method to transport the oil and gas from the platform would be subsea pipelines to the nearest landfall location, probably on the southern Kenai Peninsula; and
- onshore infrastructure is most likely to be built on the Kenai Peninsula Borough.

The largest number of oil and gas workers residing most proximate to the Sale area live in the Kenai Peninsula Borough.

We anticipate the largest number of workers to come from the Kenai Peninsula Borough. It is for these reasons that we have analyzed the economic effects, both revenue and employment and personal income, on the Kenai Peninsula Borough. We anticipate an insignificant number of workers coming from and no taxable infrastructure being built in the Lake and Peninsula Borough or the Kodiak Island Borough. We anticipate no taxable infrastructure in the Municipality of Anchorage. Workers could come from Anchorage but they would be a very small percentage of the total. We do not anticipate effects from small oil spills or small natural gas releases.

IV.B.1.j(3)(a) Routine Operations

IV.B.1.j(3)(a)1) Revenues

Alternative I would generate increases in Kenai Peninsula Borough property taxes that would average about 6% above the level of Kenai Peninsula Borough revenues without Alternative I. The revenue to the Kenai Peninsula Borough would be about \$2.7 million per year for 15 years during production. This estimate is based on the estimated value of \$222 million for the 125 kilometers (75 miles) of an onshore, 12-inch pipeline and \$3 million for 8 kilometers (5 miles) of onshore gas pipeline. We use pipeline cost data in Han-Padron Associates (1985) and Consumer Price Index annual changes (U.S. Department of Labor, Bureau of Labor Statistics as quoted in Fried and Windisch-Cole, 2001) to estimate the oil pipeline cost and value. We use data in *Petroleum News Alaska* (2001) for the gas pipeline cost and value. The approximate average mill rate of 12 for the Kenai Peninsula Borough is applied.

Alternative I would generate revenue increases to the State of Alaska of less than 0.01% above the level without it. The revenue to the State would be about \$2 million per year for 15 years during production.

IV.B.1.j(3)(a)2) Employment and Personal Income

The potential economic effects of Alternative I for employment and personal income would occur in three major phases: exploration, development, and production. In general, employment and associated personal income would be at a relatively low level in exploration, would peak during development, and drop to a plateau in production. This pattern of economic effect reflects the Exploration and Development Scenario described in Appendix B. Direct OCS workers are assumed to work on rigs on the OCS in Cook Inlet during their work time and commute to residences in the Kenai Peninsula Borough on their time off, except for a portion of the exploration workers, as explained in Section IV.B.1.j(2). Other direct OCS workers are assumed to work and reside on the west side of the Kenai Peninsula Borough or the "Rest of Alaska," which, in all likelihood, would be primarily Anchorage. A worker enclave is not assumed. For Alternative I the total employment and personal income is shown in Table IV.B-19. There would be no change over the 2000 baseline for the Kenai Peninsula Borough for each of the three major phases of OCS activity and none for the rest of Alaska for the following reasons.

We assume no inmigration of direct OCS workers to the Kenai Peninsula Borough or the rest of Alaska for various reasons. Many workers trained in oil-industry skills currently live in the Kenai Peninsula Borough and work in the oil industry in the Kenai Peninsula Borough or on the North Slope. The oil industry in both of those locations is anticipated to undergo a gradual decline over the coming decades, because old fields are being played out. Also many OCS jobs are not skilled and could be filled by the general labor force. Another factor is the seasonality of certain types of work on the North Slope; that is, many types of work on the North Slope are done only in the winter, leaving workers available for work being done primarily in the summer in Cook Inlet, especially during exploration and development. Many of the workers could find work in the OCS activity generated by the Alternative I. The availability of workers experienced in the oil industry and living in the Kenai Peninsula Borough, when demand for this type of labor is generated by Alternative I, would be determined by the unemployment at the time work associated with Alternative I is available. Even during the peak employment, 210 direct OCS workers are projected; this is less than 12% of 2000 employment in the oil and gas industry in the Kenai Peninsula Borough (see Section III.C.1 - Economy).

We also assume no inmigration of indirect and induced workers to the Kenai Peninsula Borough and the rest of Alaska. The total numbers, even during development stage, would be small compared to the total workforce in the Kenai Peninsula Borough (16,588 in 1998) and they would be distributed across a wide array of employment types.

The Proposed Action also would generate employment and personal income in the rest of the United States. The percent of change as compared to the economy of the rest of the United States is very small, so we do not analyze it here.

In the Exploration and Development Scenario for Alternative I, exploration activity would take place in 2006-2010, development activity for oil would occur in 2009-2014, and production for oil would occur in 2011-2025. Development activity for gas would be in 2022-2024, and production of gas would be in 2022-2033. Alternative I has some overlap of the three main activities of exploration, development, and production. To simplify analysis but define the primary distinctions, data for employment and personal income are presented as annual averages for the three main OCS activity categories. We assume that a drill rig would be brought in from outside of Alaska and that modules would be fabricated outside of Alaska (see Appendix B).

"Direct employment" includes those workers with jobs directly in oil and gas exploration, development, and production. "Indirect employment" includes those workers in industries that support direct exploration, development, and production activities. These include, for example, jobs in transportation such as shuttling workers by air between Anchorage and the work site. Direct and indirect workers spend a part of their earnings for expenses such as food, housing, and clothing. The aggregate of workers associated with providing those goods and services is termed "induced employment." All of the direct, indirect, and induced workers have compensation derived from their work defined as "personal income" in Table IV.B-19.

Because of the development of facilities or the continued use of facilities onshore that are taxable by the Kenai Peninsula Borough, the Borough would have additional revenues available that most likely would be used for its ongoing operations. This, in turn, would result in Kenai Peninsula Borough government jobs.

IV.B.1.j(3)(a)3) Small Oil Spills

We do not anticipate effects on the economy from small oil spills less than the 1,000 barrels described in Appendix A-1. The spills would be cleaned up by regular operations personnel.

IV.B.1.j(3)(b) Large Oil Spills

There is a 19% probability of one or more offshore spills of 1,000 barrels or greater from the Proposed Action. In the event of an unlikely large oil spill of 1,500 barrels, we estimate employment to be 60 cleanup workers for 6 months in the first year, declining to zero by the third year following the spill. For a possible large spill of 4,600 barrels, we estimate employment to be 190 cleanup workers for 6 months in the first year, declining to zero by the third year following the spill. The 60-190 workers make up about 0.6-1.9% of the workers who cleaned up the *Exxon Valdez* oil spill. For the Oil-Spill-Risk Analysis, see Appendix A.

Our estimate of employment to clean spills is based on the most relevant historical experience of a spill in Alaskan waters, the 1989 *Exxon Valdez* oil spill, which spilled 240,000 barrels. The spill generated enormous employment that rose to the level of 10,000 workers directly doing cleanup work in relatively remote locations. Smaller numbers of cleanup workers returned in the warmer months of each year following 1989 until 1992. Numerous local residents quit their jobs to work on cleanup often at significantly higher wages. This generated a sudden and significant inflation in the local economy (Cohen, 1993). Similar effects on the Kenai Peninsula Borough would be mitigated due to the likelihood that cleanup activities, including administrative personnel and spill-cleanup workers, would be located in existing enclave-support facilities. The number of workers actually used to clean up a possible 1,500-4,600-barrel oil spill would depend on a number of factors. These include what procedures were called for in the oil-spill-contingency plan, how well prepared with equipment and training the entities responsible for cleanup were, how efficiently the cleanup was executed, and how well coordinated the execution of the cleanup was among numerous responsible entities.

The difference between large offshore spills and small spills relate to area.

A large onshore oil spill of 2,500 barrels is assumed (se Section IV.A.4.a). It also is assumed that no cleanup would be done; therefore, no workers would be needed.

IV.B.1.j(3)(c) Large Gas Releases

We anticipate no effects from the release of 10 million cubic feet of natural gas during production. In the event of a gas blowout, we assume the gas would disperse into the air without burning. The amount of work to repair the gas well after a blowout would be minimal.

IV.B.1.j(3)(d) Components of the Kenai Peninsula Borough Economy

Native residents of the Kenai Peninsula Borough traditionally have relied on subsistence activities. Although not fully part of the cash economy, subsistence hunting is important to the economy for those practicing subsistence and even more important to culture. For effects on these aspects, see Sections IV.B.1.1 - Subsistence-Harvest Patterns and IV.B.1.m - Sociocultural Systems. Other components of the Borough's economy are commercial fisheries, recreation and tourism, sport fisheries, and activities in national and State parks described in Sections IV.B.1.k, IV.B.1.n, IV.B.1.o, and IV.B.1.r, respectively.

IV.B.1.j(4) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

There would be no difference in economic effects between Sales 191 and 199.

IV.B.1.j(5) Effectiveness of Mitigating Measures

Stipulations would not alter the economic effects analyzed in this section.

IV.B.1.k. Effects of Sale 191 on Commercial Fisheries

The central Gulf of Alaska supports a large and diverse commercial fishery for shellfish, salmon, herring, and groundfish. Recent harvest numbers and values, including fishing seasons and vessel and gear descriptions, are discussed in Section III.C.2. For purposes of analysis, the effects of Alternative I on the commercial fishing industry in these waters has been estimated on the basis of (1) space-use conflicts due to routine activities and (2) the economic cost of oil spills to the commercial fishing industry. The likely effect of these events on fish populations has been addressed in Section IV.B.1.d.

IV.B.1.k(1) Conclusion

Based on the assumptions discussed in the text, loss estimates from the Exxon Valdez oil spill, and the average annual value of the Cook Inlet commercial fishery (about $41 million), the occurrence of a 4,600-barrel-oil spill in lower Cook Inlet could cause closure of the fishery over tainting concerns and result in a loss to commercial fisheries of about 22-37% per year for 2 years. It is possible the fishery could be closed *for a whole season, resulting in a 100% loss for that year. Losses of this magnitude constitute a significant impact. While annual losses to the Kodiak commercial-fishing industry likely would to be similar to those of the Cook Inlet area, they likely would occur over a longer period and ultimately could result in greater losses overall. Losses of this magnitude likely would have a significant impact on the Cook Inlet and Kodiak commercial-fishing industry and do not include losses due to damaged boats and gear. Losses to the commercial-fishing industry from a 4,600-barrel spill occurring in winter may be reduced. The Oil-Spill-Risk Analysis estimates there is a 19% probability that one or more spills greater than or equal to 1,000 barrels could occur.*

IV.B.1.k(2) Effects from Exploration

Except for the occurrence of a large oil spill, the effects of exploration and production related activities on commercial fishing are expected to be essentially the same, and are discussed under development and production. While there may be differences in the amount or type of activities between exploration and production, those differences would not make a measurable difference on the commercial fishing industry.

IV.B.1.k(3) Effects from Development and Production

IV.B.1.k(3)(a) Effects on the Shellfish Commercial Fishery

Cook Inlet and the waters adjacent to Kodiak and Chignik have supported commercial shellfish fisheries for red king, horseshoe, tanner, and Dungeness crabs; weathervane scallops; hard shell clams, razor clams (Cook Inlet); shrimp; and in recent years, sea urchins and sea cucumbers (Kodiak and Chignik). Due to low abundance levels in the Cook Inlet area, the fisheries for red king, tanner, and Dungeness crabs and for shrimp have been closed for some time. Only fisheries for weathervane scallops and hard shell and razor clams remain open in the Cook Inlet area. Due to low abundance levels in the Kodiak area, the red king crab commercial fishery has been closed since 1995. There is potential for commercial crab harvesting in the future, should stocks in the Inlet recover.

Seismic-exploration vessels towing long cables have had a history of conflicts with the commercial-fishing industry in Cook Inlet (Flagg, 1992). In the mid- to late 1970’s when extensive exploration was occurring in the lower Cook Inlet OCS lease area, these conflicts were frequent and of a serious nature. Crab fishermen reported losing hundreds of pots and halibut fishermen the loss of several miles of longline during this exploration period. In some cases, fishermen simply were forced away from their normal fishing grounds to avoid the heavy loss of gear. Other gear loss has been reported over the years from tugs towing barges or drilling platforms and from tanker traffic (Flagg, 1992).

In January 1975, the 8,000-ton jackup drilling rig George F. Ferris was moved down into Kachemak Bay from the upper Inlet where it had experienced mechanical problems (Flagg, 1992). The rig was towed past the Bluff Point Dungeness crab grounds on the north side of the bay, where it allegedly entangled several dozen Dungeness crab pots and raised the ire of commercial shellfish fishermen, because they had asked to be notified when the rig was being moved. A few fishermen were able to settle their claims for lost pots with industry while the Ferris moved on to other difficulties. It proceeded to drop its legs in an area inside Kachemak Bay known as Mud Bay. The legs of the jackup rig stuck firmly in 82 feet of mud and clay. Later, when crews unsuccessfully tried to raise the legs by using the rising tide against the bottom of the rig, the Ferris was swamped, creating an oil slick 2-3 miles in length.

The commercial shellfish fishery in lower Cook Inlet could be affected by drilling discharges, offshore construction, and seismic surveys. Drilling discharges typically affect only a limited area near a drilling platform, and are not expected to affect commercial fishing for shellfish. Offshore construction, platforms, and pipelines may infringe to some extent on commercial fishing for shellfish. However, only one production platform is assumed for Alternative I. A drilling platform is not likely to measurably displace commercial fishing, because it closes less than 0.5 square kilometers to commercial fishing. This number is based on accepted rules of navigation for avoidance of structures and is expected to result in minimal interference. Seismic surveys or drilling platform movements can entangle buoy lines for crab pots with consequent loss, as previously described. However, cooperation between the seismic-survey industry and the commercial-fishing industry has minimized these space-use conflicts. Commercial fishermen may be compensated for gear loss or damage attributable to offshore oil and gas operations, however, the MMS cannot ensure that commercial fishermen will be reimbursed for their losses to industry operations. Because Cook Inlet is closed to commercial crab fishing, conflicts of this nature are less likely to occur. In the event that commercial crab fishing in Cook Inlet reopened or was conducted for stock-assessment purposes, conflicts also may be avoided by conducting seismic surveys during closed fishing periods or seasons. The navigation rules for vessel traffic also serve to avoid potential conflicts.

The most threatening impact to any commercial fishery is a large oil spill, with both gear and catch at risk. Even if a fishery is not contaminated by oil from a large spill, the fishery may be closed and perceived as being contaminated or tainted. Such fishing closures may result in the loss of income, and/or marketing problems. In addition to the large oil spill (4,600 barrels), the oil-spill scenario in Section IV.A.4 assumes a number of small spills occur under Alternative I. Due to the relatively small amount of oil involved, small oil spills are not expected to result in closures or reduced market values over the life of the Proposal. However, if a large oil spill occurred during a shellfish-fishing season, the Cook Inlet commercial-shellfish industry is likely to be affected by closures. Such a spill likely could affect shellfish in nearshore-subtidal and intertidal areas but not those in deeper waters, where oil residues seldom reach (Laevastu et al., 1985; also see Section IV.B.1 of this EIS). Weathervane scallop beds that are commercially harvested off Augustine Island in 38-115 meters (120-360 feet) of water likely would go undamaged in the event that an oil spill passes through the area. In all likelihood, their depth would serve to segregate them from direct impacts associated with a floating oil slick at the sea surface. However, these scallop beds may become commercially unacceptable for market due to actual or perceived contamination and tainting. Actual contamination is possible; however, the likelihood is regarded as low, in part due to the large water exchanges that occur as part of the dynamic hydrography of Cook Inlet.

IV.B.1.k(3)(b) Effects on Salmon and Herring Commercial Fisheries

In Cook Inlet and the waters adjacent to Kodiak, Chignik, and the southern Alaska Peninsula, all five species of Pacific salmon are harvested commercially (as well as for subsistence and sport). Second only to Alaska's groundfish fishery, Alaska's salmon fishery is one of the largest fisheries in volume and value. Salmon fisheries in Shelikof Strait and near Kodiak Island are closely equivalent to those in Cook Inlet, with slightly different fishing seasons and periods. Cook Inlet and Kodiak salmon fisheries use purse seines, drift gillnets, set gillnets, and, in small numbers, beach seines. The regional salmon fisheries commence in early May and continue well into September each year. Pacific herring also may be harvested annually in Cook Inlet and the waters adjacent to Kodiak, Chignik, and the southern Alaska Peninsula. Gillnets are currently the only legal gear for herring in upper Cook Inlet, with setnets being used almost exclusively. There are three primary fisheries in the upper Cook Inlet area, the eastside, the Chinitna Bay, and Tuxedni Bay fisheries. Due to low stock abundance, all of these were closed to fishing by 1993. In 1998, the eastside fishery was reopened from April 15 to May 20 but only for 2 days a week.

Drilling discharges, offshore construction, platforms, and pipelines are not expected to affect purse-seine fisheries, because they usually occur some distance from OCS activities. Seismic surveys might cause temporary disturbance and dispersal to fish and thus may reduce a purse-seine harvest. This would be limited to the time of the survey, probably to no more than 1 hour following passage of the airgun array (Pearson, Mokness, and Skalski, 1993). Purse-seine vessels fish in Shelikof Strait from late spring through the summer annually, with some regulatory closed periods. These vessels harvest herring and salmon and work mainly within State waters. Oil spills could contaminate purse seines and the harvest. A large oil spill before or during the season when purse-seine vessels are active could force closure of short-period, high-value, commercial fisheries (for example, sac-roe herring).

Drift-gillnet vessels in the Cook Inlet area fish for herring in mid-April through May 20 and for salmon into August. Drilling discharges are not expected to affect the drift-gillnet fisheries. Seismic surveys could affect the drift-gillnet industry because seismic noise may disperse herring and salmon and reduce the catch. However, this is likely to be limited to the immediate area of the surveys and to the few hours during survey operations. Because the drift-gillnet industry normally fishes within 3 miles of the beach, seismic surveys associated with the Alternative I are not likely to affect it. In cases where drift-gillnet fishers fish farther out in Cook Inlet, space-use conflicts with the seismic-survey vessel, exploration-drilling unit, and/or production platform are possible. Such conflicts between oil and gas activities with fisheries in Cook Inlet have been noted in the past by Flagg (1992) and are described in Section IV.B.1.k(3)(a). Potential space-use conflict issues were addressed as a result of Sale 149. Recently, the

MMS sponsored mapping Cook Inlet riptides using local knowledge of the commercial fishers and remote sensing (LGL Alaska Research Associates, Inc. 2000). Stipulation No. 1, which emerged from discussions with the fishing industry during the Sale 149 process and which was discussed during scoping for Sale 191, requires that activities be planned and coordinated with the commercial-fishing industry and is expected to make conflicts rare to nonexistent. Space conflicts associated with the transportation of platforms or logistics (supplies or personnel) between construction or production sites and shore bases will need to be coordinated between the lessees and operators and the commercial-fishing industry during planning exercises as specified in Stipulation No. 1. As with other fisheries, an oil spill could damage drift-gillnet gear (primarily floats and float lines) and result in possible areawide fishing closures.

The bays and beaches of Cook Inlet also have a number of setnet sites where gillnets are anchored to the beach or slightly offshore, and are used to harvest salmon and herring. These operations could be affected by oil spills but are not likely from discharges, construction, or seismic-surveys due to the typical distance from OCS activities, with the noted space use exceptions in the previous paragraph. Oil spills could damage setnet fisheries, as evidenced by the *Exxon Valdez* oil spill of 1989. Relatively small volumes of weathered oil entered the lower Cook Inlet region, but the commercial salmon fishery was closed to protect both gear and harvest from possible contamination. A spill the size of the assumed spill (4,600 barrels) in Cook Inlet, itself is even more likely to result in the area being closed to commercial fishing than it was due to the *Exxon Valdez* oil spill. Hence, the occurrence of a 4,600-barrel oil spill is likely to have a greater overall effect on the commercial-fishing industry in Cook Inlet than the *Exxon Valdez* oil spill did.

IV.B.1.k(3)(c) Effects on Commercial Groundfish Fisheries

Groundfish are commercially harvested in Cook Inlet and the waters adjacent to Kodiak and the southern Alaska Peninsula. The groundfish fishery is the largest commercial fishery in Alaska in both volume and value. Commercially harvested groundfish include rockfish (numerous species), flatfish (including halibut), Pacific cod, lingcod, sablefish, and pollock. One or more of these fisheries may operate during most of the year in the Cook Inlet, Kodiak, Chignik, and the southern Alaskan Peninsula areas. Groundfish in this area are most commonly harvested with either trawl or longline gear.

Drilling discharges, limited in area and number over time, are expected to have no measurable effect on longline or trawl fisheries of the Cook Inlet area. Offshore platforms would foreclose less than 1 square kilometer to longline fishing, and the presence of an offshore pipeline would not interfere with longlining. Offshore construction, platforms, and pipelines are not likely to interfere with trawling. However, to avoid the drilling platform, a bottom trawler would need to divert course within 1.6 kilometers (1 mile) of the structure under normal sea conditions and not pass over exposed pipelines. Halibut fishermen reported the loss of several miles of longline to seismic-survey operations during explorations of lower Cook Inlet during the late 1970's (Flagg, 1992). Seismic vessels may entangle longline buoy lines. Offshore construction activities and seismic surveys that are planned and coordinated with the commercial-fishing industry may minimize space-use conflicts and have the potential to minimal impacts on the commercial-fishing industry.

Longline fisheries for halibut (the only substantial groundfish fishery currently in Cook Inlet), Pacific cod, black cod, and miscellaneous other fish species could be affected by oil. Some lines and buoys fouled with small amounts of oil may be unfit for future use. Oil spills could contaminate trawl gear because such gear is operated over extensive areas and, depending on catch rate, may operate 24 hours a day. Although it is unlikely that a trawler would be operating in an oiled area, the catch could be contaminated by oil and rendered unfit for consumption and unprofitable if it passed through such an area. For an assumed 4,600-barrel spill, this area could range from 265-1,100 square kilometers (given the estimated discontinuous area after 10 and 30 days, respectively, from Table A.1-3).

IV.B.1.k(3)(d) Effects on Fish Hatcheries and Aquatic Farms

The MMS does not expect adverse impacts to fish hatcheries or aquatic farms from routine exploration and development activities as a result of the proposed lease sale. The oil-spill-risk analysis model does not indicate that hatcheries would be impacted by a large oil spill introduced by OCS activities.

IV.B.1.k(3)(e) Estimated Economic Costs of a Large Oil Spill on the Commercial-Fishing Industry

As discussed previously, drilling discharges, offshore construction, and seismic surveys associated with Alternative I are not expected to have a measurable effect on the commercial fishing industry. The opposite is true concerning large oil spills since they are the primary factor likely to adversely affect the commercial-fishing industry in any region. Due to the relatively small amount of oil involved, the small oil spills considered for Alternative I (based on the oil spill scenario in Section IV.A.4) are not expected to result in closures or reduced market values over the life of the proposal. Hence, they are not expected to have a measurable economic effect on the commercial-fishing industry in this region. This section estimates the costs to the commercial-fishing industry resulting from the large oil spill considered for Alternative I (either 1,500 or 4,600 barrels). For purposes of analysis, the 4,600-barrel oil spill is assumed because it would have the greater effect. Economic costs are defined as any measurable cost associated with reduced catches (for example, closures due to an oil spill), reduced market value, gear loss, or any measurable increased cost due to Alternative I. The estimated economic effect of space-use conflicts (related or unrelated to the oil spill) associated with Alternative I is incorporated into the estimate of economic costs.

The economic cost of a large oil spill to the commercial-fishing industry is primarily due to fishing closures, catch tainting (real or perceived), and gear contamination. The two oil spills that provide the most insight in this regard are the *Exxon Valdez* oil spill and the *Glacier Bay* oil spill. However, it should be noted that the information concerning these two spills suggests that different methods for estimating economic loss to commercial fishing were used (Cohen 1993, USDOI, MMS, 1990). For example, the *Exxon Valdez* oil spill was analyzed on the basis of agency reports and modeling efforts whereas the analysis of the *Glacier Bay* oil spill was based primarily on interviews with processors and commercial fishers. Furthermore, much of the information needed for the analysis of these two spills was either missing, incomplete, or withheld. Hence, the following estimate of economic costs to the commercial-fishing industry of Cook Inlet is also limited by these same factors.

The *Exxon Valdez* oil spill was a 240,000-barrel oil-tanker spill that occurred in Prince William Sound on March 24, 1989, just before the commercial-fishing season. The *Exxon Valdez* oil spill primarily affected the commercial herring and pink salmon fisheries in Prince William Sound. The ex-vessel losses following the *Exxon Valdez* oil spill were estimated to have ranged between $6.4 and $41.8 million in 1989 and between $11.1 and $44.5 million in 1990. These estimates are based on economic modeling and have a wide range due to the variability of natural and economic conditions that affect the value of the fisheries. However, the financial compensation received by the commercial-fishing fleet during the cleanup process was not factored into these estimates. That compensation was estimated to have exceeded, by several orders of magnitude, the revenue lost due to the oil spill (Cohen, 1993). Although participation in the *Exxon Valdez* oil spill cleanup and compensation to individual commercial fishers was not evenly distributed, some fishers received substantial compensation while others received little or none. Due to the distance to Cook Inlet from the *Exxon Valdez* oil spill site, relatively little of the *Exxon Valdez* oil spill oil actually reached Cook Inlet, and what did enter Cook Inlet was heavily weathered.

The *Glacier Bay* oil spill was a 3,100-barrel oil-tanker spill that occurred in upper Cook Inlet on July 2, 1987, during the commercial-fishing season. The *Glacier Bay* oil spill had its primary effect on a king and sockeye salmon fishery in Cook Inlet. The estimated economic losses associated with this spill were based primarily on discussions with driftnet and setnet salmon fishers. Although losses experienced by processors would have been an important component in the overall commercial-fishing-industry analysis, they did not provide the necessary information to be included in the analysis. Losses reported by driftnet fishers ranged from about $10 to $108 million: setnet fishers reported losses from $12-$82 million (USDOI, MMS, 1990). However, the entire Cook Inlet fishery for all species (salmon, herring, groundfish, and shellfish) during that period is estimated to have had an exvessel value of $50 to $135 million, depending on the price per year and numbers caught. Hence, from the estimated value of the Cook Inlet commercial fishery, it appears that the upper-loss estimates from the *Glacier Bay* oil spill (due mostly to closures) provided by Cook Inlet salmon fishers were high (totaling $190 million). This claim must include fishing gear and other losses, because the total appears to be greater than the combined value of all commercial fisheries in Cook Inlet for that year. The *Exxon Valdez* oil spill was about 60 times the size of the *Glacier Bay* oil spill and only resulted in maximum loss estimates of $40 to $45 million per year for the

2 years following the spill. For these reasons, the *Exxon Valdez* oil spill loss estimates are used in this analysis rather than the *Glacier Bay* oil spill estimates.

Because the 4,600-barrel oil spill assumed for Alternative I is about 52 times smaller than the *Exxon Valdez* oil spill (240,000 barrels), it is likely to have (depending on closures) less of an effect on the Cook Inlet commercial-fishing industry than the *Exxon Valdez* oil spill. However, it is also likely that the Cook Inlet oil spill would deposit more oil (particularly fresh oil) in Cook Inlet than the *Exxon Valdez* oil spill. Hence, it is assumed that the 4,600-barrel oil spill would have at least an equal economic effect as that of the *Exxon Valdez* oil spill, and that it occurs at the beginning of the primary Cook Inlet commercial fishing season (spring). If the Cook Inlet and Prince William Sound commercial fisheries are assumed to be of similar value, the Alternative I-oil spill is estimated to result in economic losses to the Cook Inlet commercial-fishing industry of about $18 million (the sum of the lower 2-year *Exxon Valdez* oil spill loss estimates) to about $86 million (the sum of the higher 2-year *Exxon Valdez* oil spill-loss estimates) (Cohen, 1993). Hence, the occurrence of a 4,600-barrel oil spill would be estimated to result in an economic cost to the commercial-fishing industry of about $9 to $43 million per year for 2 years.

From 1983-1993, the value of the Cook Inlet commercial fishery appears to have ranged between about $50 and $130 million. From 1991-2001, the value of the Cook Inlet commercial fishery ranged between about $33 and $115 million, and averaged $41 million for that period). These numbers include all fish taken from Cook Inlet waters, including those harvested by out of state residents in Cook Inlet. Based on the above, in any 2-year period when the value of the Cook Inlet commercial fishery is estimated to be about $33 million per year, a 2-year loss of about $9 million per year represents a 27% ($9 million/$33 million x 100) per year loss for 2 years. In a 2-year period when the annual value of the Cook Inlet commercial fishery is estimated to be closer to $115 million, a 2-year loss of $43 million per year represents a 37% per year loss for 2 years. However, because a 4,600-barrel oil spill would preclude any knowledge of what the commercial fishery would have been worth that year had the spill not occurred, the value of the commercial fishery for the years affected by the spill is assumed here to be the average annual value of the Cook Inlet commercial fishery. It is possible the fishery could be closed for a whole season, resulting in a 100% loss for that year. In terms of the average annual value (about $41 million), a 2-year loss of about $9 million per year represents a 22% per year loss for 2 years to a 100% loss if the fishery is closed for a whole year. These loss estimates do not include losses due to damaged boats and gear.

While the value of the commercial fisheries in Cook Inlet and Kodiak have differed considerably from year to year, the general trend has been that the value of the Kodiak commercial fishery is greater than that of the Cook Inlet commercial fishery. The estimated total ex-vessel value of all commercial fisheries in 1995 was about $37 million in Cook Inlet whereas, it was about $100 million in Kodiak based on personal communication with the State of Alaska, Department of Fish and Game (2002). Due to low abundances, many of Cook Inlet’s commercial fisheries have either been closed or greatly reduced in the last 20 years. Currently (2002), the only commercial fisheries contributing more than 1% to Alaska’s total commercial ex-vessel value in Cook Inlet are its salmon fisheries (about 6%) and halibut fisheries (about 10%). While the ex-vessel value produced by the Kodiak commercial fishing industry has also been reduced in the past 20 years, shellfish in the Kodiak area contribute less than 1% to the State’s total ex-vessel shellfish value. In 1995, Kodiak herring fisheries (about 11%), salmon fisheries (about 11%), groundfish fisheries (about 5%), and halibut fisheries (about 21%) were all major contributors to the State’s total ex-vessel value of these fisheries Statewide.

As shown in Table IV.B-21, from 1991-2001, the estimated average annual value of the Kodiak commercial-fishing industry was nearly twice that of the Cook Inlet commercial-fishing industry (about $77.5 million). However, less than half of the Kodiak commercial-fishing income was derived from fishing in the Shelikof Strait area, which is the only area around Kodiak Island likely to be contacted by a large oil spill originating in Cook Inlet. Hence, estimated economic losses to the Kodiak commercial fishing industry are expected to be about equal to those estimated for Cook Inlet). However, Kodiak’s western shoreline in Shelikof Strait contains a vast number of areas where oil can be trapped and the oil is likely to remain a great deal longer than it would in Cook Inlet. This increases the likelihood that this prime commercial fishing area would remain closed longer than that of Cook Inlet. Hence, while annual losses in the Kodiak area are likely to be similar to those of the Cook Inlet area, they are likely to occur over a longer period than they would in Cook Inlet and may ultimately result in greater overall losses.

Nevertheless, based on the *Exxon Valdez* oil spill experience, compensation to the commercial-fishing industry for participating in the cleanup of an oil spill is likely to exceed these economic losses many times.

The occurrence of a 4,600-barrel oil spill during winter is likely to reduce the extent of closures in the following spring and summer. Winter closures in the areas where the oil spill occurred or contacted are possible; however, winter commercial fisheries are deepwater fisheries and are likely to be much less affected by closures due to oil spills. This is due to two beliefs that are generally accepted by most involved:

1. The first is that winter weather in Alaska would quickly dissipate the oil (particularly the more toxic hydrocarbons) due to frequent winter-storm activity.
2. The second is that adult fish and shellfish would not be contacted by hydrocarbons from the spill anyway, because most hydrocarbons remain close to the surface. Very little (if any) hydrocarbons would be likely to reach the zone where commercial fishes are harvested during winter.

For these reasons, and the fact that there are far fewer ongoing commercial fisheries in winter, closure of winter commercial fisheries due to a large oil spill is much less likely than one that occurred in the spring. Hence, economic losses to the commercial fishing industry due to a large winter oil spill are likely to be far less than what would be expected from that same spill occurring in the spring.

Section IV.B.1.j - Effects of Sale 191 on the Economy has additional analyses concerning effects on commercial-fisheries employment.

IV.B.1.k(3)(f) Estimated Economic Costs of a Large Gas Release on the Commercial-Fishing Industry

An accidental release of natural gas from a gas well blowout or pipeline rupture is not expected to have measurable effects on Cook Inlet commercial fishing.

IV.B.1.k(4) Summary

Drilling discharges associated with Alternative I are not expected to affect commercial fishing due to the limited area affected near the platform-discharge point. Offshore transportation and construction, the platform, and pipelines are expected to result in some space-use conflicts; however, these are expected to be few in number and minor in scope. Seismic surveys and other platform and vessel movements, when planned and coordinated with the commercial-fishing industry, are expected to minimize effects on the Cook Inlet commercial-fishing industry. Similarly, space-use conflicts in the rip tides are expected to be minimized. Relatively small spills considered for Alternative I are not expected to result in closures or reduce market values over the life of the Proposal. Hence, they are not expected to have a measurable economic effect on the Cook Inlet commercial-fishing industry.

The occurrence of a 4,600-barrel oil spill is likely to affect pot, longline, trawl, drift-gillnet, and set-gillnet fisheries in Cook Inlet and possibly the waters in the Kodiak/Shelikof Strait area (depending on the location of the spill). The estimated economic effect of a large oil spill on the Cook Inlet area commercial-fishing industry is based on what occurred during the *Exxon Valdez* oil spill and *Glacier Bay* oil spill, and primarily depends on the highly variable *Exxon Valdez* oil spill cost estimates (ranging from $9-43 million per year for 2 years).

From 1983-1993, the value of the Cook Inlet commercial fishery appears to have ranged between about $50 and $130 million. From 1991-2001, the value of the Cook Inlet commercial fishery ranged between about $33 and $115 million, and averaged $41 million for that period. Any 2-year period when the value of the Cook Inlet commercial fishery is estimated to be about $33 million per year, a 2-year loss of about $9 million per year represents a 27% ($9 million/$33 million x 100) per year loss for 2 years. In a 2-year period when the annual value of the Cook Inlet commercial fishery is estimated to be closer to $115 million, a 2-year loss of $43 million per year represents a 37% per year loss for 2 years. However, because a 4,600-barrel oil spill would preclude any knowledge of what the commercial fishery would have been worth that year had the spill not occurred, the value of the commercial fishery for the years affected by the spill is assumed here to be the average annual value of the Cook Inlet commercial fishery. It is possible the fishery could be closed for a whole season, resulting in a 100% loss for that year. In terms of the average annual value (about $41 million), a 2-year loss of about $9 million per year represents a 22% per year loss for 2 years to a 100% loss if the fishery is closed for a whole year. These loss estimates do not include losses due to damaged boats and gear. Such losses constitute a significant impact to commercial fisheries.

IV.B.1.k(5) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

If the scenario takes place exclusively as the result of Lease Sale 199, the activities would be undertaken 2 years later (starting in 2006) but would not differ in location, duration, or magnitude. The actions would cause the same effects described for Sale 191, only 2 years later.

IV.B.1.k(6) Effectiveness of Mitigating Measures

Mitigating measures that would have the most effect on commercial fisheries include the stipulation on the Protection of Fisheries, the potential stipulation on Restriction on Multiple Operations, and the ITL on Oil Spill Response Preparedness. With these mitigating measures in place, there is an increased probability that (1) conflicts between the oil and gas industry and Cook Inlet commercial fishing industry (including driftnet fishers) would be minimized, and (2) less oil would reach the commercial-fishing grounds following a large oil spill. To the degree that they are implemented, these mitigating measures are expected to benefit the Cook Inlet commercial fishing industry; however, their absence is likely to result in unnecessary and costly conflicts between the oil and gas industry and commercial-fisheries industry.

IV.B.1.l. Effects of Sale 191 on Subsistence-Harvest Patterns

This section analyzes the potential impacts of proposed Sale 191 on subsistence resources and subsistence-harvest patterns in communities in upper Cook Inlet, central Kenai Peninsula, lower Kenai Peninsula, Kodiak Island, and the southern Alaska Peninsula. Subsistence resources and subsistence-harvest patterns are described in Section III.C.3. Routine activities associated with this exploration, development, and production that may affect subsistence resources and harvest patterns include drilling discharges, movement and noise associated with the drilling rig, support-vessel traffic, helicopter flights, well abandonment, seismic surveys, platform construction and operation, and pipeline construction.

Accidental activities that could affect these resources include exposure to spilled oil. For purposes of analysis, during the course of this project, one large oil spill greater than or equal to 1,000 barrels and a number of small oil spills (based on the oil-spill scenario in Section IV.A.4) are assumed to occur. For purposes of analysis, this EIS also assumes that one 1,500-barrel platform spill or one 4,600-barrel pipeline spill would occur.

IV.B.1.l(1) Conclusion

For the communities in upper Cook Inlet, central Kenai Peninsula, lower Kenai Peninsula, Kodiak Island, and the southern Alaska Peninsula, short-term, local disturbance from routine activities associated with exploration, development, and production could periodically affect subsistence resources and subsistence-harvest patterns, but no resource or harvest area would become unavailable, no resource would experience an overall decrease in population, and no harvest would be curtailed for the harvest season. As discussed under routine effects in Section IV.B.1.i - Terrestrial Mammals, construction disturbance and noise could briefly disturb subsistence species that include beluga whales, seals, sea lions, fish, birds, moose, bears, and Sitka black-tailed deer, and only a few actual animals would be temporarily displaced. An unlikely large oil spill could contact environmental-resource areas where important subsistence resources are present. Some harvest areas and resources in these locations would be too contaminated to harvest. Some resource populations could suffer losses and, as a result of tainting, an even larger array of resources could be rendered unavailable for use. Tainting concerns in communities nearest the spill could seriously curtail traditional practices for harvesting, sharing, and processing resources and threaten pivotal practices of traditional Native culture—practices only now recovering from the impacts and aftermath of the Exxon Valdez oil spill in 1989 (Fall and Utermohle, 1999; Fall et al., 2001). Harvesting, sharing, and processing of subsistence resources would continue but would be hampered to the degree these resources were contaminated. In the case of contamination, harvests would cease until such time as local subsistence hunters perceived resources as safe. Oil-spill cleanup would increase overall effects by displacing *subsistence species, altering or reducing subsistence-hunter access, and altering or extending the normal period of the subsistence hunt.*

IV.B.1.l(a) Summary of Impacts on Subsistence Resources and Harvest Patterns

The Oil-Spill-Risk Analysis estimates the chance of an oil spill occurring and contaminating subsistence resources and resource-harvest areas at 19%. This is the chance that one or more spills greater than or equal to 1,000 barrels would occur. Based on the assumption that a spill has occurred, the chance of a large platform or pipeline spill contacting important harvest areas over a 30-day period would be 70% or less for one upper Cook Inlet subsistence environmental resource area, 14% or less for the central Kenai area, 23% or less for the lower Kenai area, 8% or less for Kodiak Island, and 2% or less for the southern Alaska Peninsula. Overall, a potential large spill could produce low to moderate effects—resources and harvests affected for at least one harvest season with some resource populations requiring longer to recover—on the subsistence resources (including shellfish), harvest areas, and harvest patterns in traditional communities in upper Cook Inlet, central Kenai Peninsula, lower Kenai Peninsula, Kodiak Island, and the southern Alaska Peninsula.

In the unlikely event of a large oil spill, some harvest areas and resources in these locations would be too contaminated to harvest. Some resource populations could suffer losses and, as a result of tainting, an even larger array of resources could be rendered unavailable for use. Tainting concerns in communities nearest the spill could seriously curtail traditional practices for harvesting, sharing, and processing resources and threaten pivotal practices of traditional Native culture—practices only now recovering from the impacts and aftermath of the *Exxon Valdez* oil spill in 1989 (Fall and Utermohle, 1999; Fall et al., 2001). Harvesting, sharing, and processing of subsistence resources would continue but would be hampered to the degree these resources were contaminated. In the case of contamination, harvests would cease until such time as local subsistence hunters perceived resources as safe.

All areas directly oiled, areas to some extent surrounding them, and areas used for staging and transportation corridors for spill response would not be used by subsistence hunters for some time following a spill. The duration of avoidance by subsistence hunters would vary, depending on the volume of the spill, the persistence of oil in the environment, the degree of impact to the resources, the time necessary for recovery, and the confidence in assurances that the resources were safe to eat.

Even though subsistence-harvest levels have returned to pre-*Exxon Valdez* oil-spill levels in all traditional communities of the region, some major changes have occurred in terms of types of resources harvested. More fish but fewer marine mammals are now harvested, and greater harvest effort in many cases is required to harvest the same amount of resource. Regional subsistence hunters do not feel that they have culturally and economically recovered from the event. For this reason, potential spill effects from Sales 191 and 199, no matter how unlikely or slight, must still be seen in light of social and cultural disruptions that linger from the devastation of the *Exxon Valdez* oil spill (Fall and Utermohle, 1999; Fall et al., 2001).

For the communities in upper Cook Inlet, central Kenai Peninsula, lower Kenai Peninsula, Kodiak Island, and the southern Alaska Peninsula, short-term, local disturbance from routine activities associated with exploration, development, and production could periodically affect subsistence resources and subsistence-harvest patterns, but no resource or harvest area would become unavailable, no resource would experience an overall decrease in population, and no harvest would be curtailed for the harvest season. As discussed under routine effects in Section IV.B.1.i - Terrestrial Mammals, construction disturbance and noise could briefly disturb subsistence species such as beluga whales, seals, sea lions, fish, birds, moose, bears, and Sitka black-tailed deer; however, only a few actual animals would be temporarily displaced. Oil-spill cleanup would increase overall effects by displacing subsistence species, altering or reducing subsistence-hunter access, and altering or extending the normal period of the subsistence hunt.

IV.B.1.l(2) Effects from Exploration on Subsistence Resources

IV.B.1.l(2)(a) Effects of Noise and Disturbance

Routine activities associated with this exploration, development, and production that could produce noise and disturbance effects on subsistence resources and harvest patterns include movement and noise associated with the drilling rig, support-vessel traffic, helicopter flights, well abandonment, seismic surveys, platform construction and operation, and pipeline construction.

For fish resources, displacement or injury from drilling or seismic activities is not estimated to be measurable. Noise associated with seismic exploration conducted in the lower inlet, particularly in or near the entrances to Cook Inlet, is not estimated to significantly affect the behavior of beluga whales that spend more time in the upper inlet. Noise and disturbance associated with vessel transit to platforms could have temporary impacts on the behavior of beluga whales during the winter. Beluga whales occasionally inhabit areas in which exploration-related noise and disturbance could occur. However, available data indicate at present their use of such areas is low. In summer, belugas tend to be concentrated in the extreme upper inlet, and the Cook Inlet population of beluga whales has shared Cook Inlet with oil and gas exploration and development for years with no apparent ill effects.

The impacts on marine and coastal birds from exploration activities are limited to the effects of helicopter flights (for example, abandonment of roosting or foraging areas, nest abandonment, and lowered reproductive success) on those relatively few nesting or roosting individuals directly under or in close proximity (a few hundred feet) of the regular flight path. These impacts could continue for 1-2 years if birds adapt to the flights, or the life of the project if birds fail to adapt. Platform-installation activities associated with exploration could temporarily displace (for one season) seals and perhaps some cetaceans near the platform-installation sites. During the exploration period (2006-2010), there could be some brief displacement of seals and cetaceans (perhaps a few minutes to less than 1 hour) because of noise and movement of aircraft (1.25-2.5 round-trip flights per day or 38-75 per month) between Kenai and the drill platform and supply boats (0.6-1.25 round trips per day or 18-38 per month) between the drill platform and the harbor facility at Nikiski. These effects are estimated to be local, within about 1 mile (1.6 kilometers) of the aircraft- and boat-traffic routes, and disturbance of harbor seals and cetaceans along these traffic routes is estimated to be short-term (a few minutes to less than 1 hour). Cetaceans and seals may be temporarily displaced (up to about 1 kilometer [.62 mile] for cetaceans and a few hundred meters for seals) from these seismic activities; however, it is estimated that displaced animals would return to normal behavior and distribution after operations are complete.

Some brief (perhaps a few minutes to less than 1 hour) displacement of brown bears, moose, and other terrestrial mammals on the Kenai Peninsula could occur because of noise and movement of aircraft traffic (60 helicopter flights per month) between the Kenai/Nikiski area and the drill platform located in the lower Cook Inlet area; similar disturbance is estimated from marine-vessel-support traffic (18-38 supply boats per month) between the drill platforms and a marine-support facility in the Kenai area. These effects are estimated to be local, within about 1 mile (1.6 kilometers) of the aircraft- and boat-traffic routes, and to have no lasting effect on bears or other terrestrial mammals.

IV.B.1.I(2)(b) Effects of Drilling Discharges

The estimated mass/volume of drilling discharges would have no estimated effect on pelagic or semidemersal fishes inhabiting the waters of the sale area. The area affected over time is too limited to have measurable adverse effects on fish. However, in some operations, the discharge points are benthic. If demersal fishes are present at the time of discharge, it is estimated that they would be disturbed and displaced from the immediate vicinity of the discharge, within a radius probably not to exceed 328 feet (100 meters). This is variable to some degree on factors such as water depth and currents. Effects on demersal fishes are estimated to be limited to the short period when materials are being discharged. Platform discharges are not estimated to have an effect on birds due to the high degree of dilution that would occur and the fact that no bioaccumulation of associated pollutants is estimated.

IV.B.1.I(3) Effects of Development and Production

IV.B.1.I(3)(a) Effects from Routine Development and Production Operations

The effects of routine operations are estimated to occur if the proposed leasing occurs and results in exploration, development, and production activities. Routine operations that may affect subsistence resources include disturbances from transportation, pipelines, and small oil spills.

IV.B.1.l(3)(a)1) Effects from Transportation and Pipeline and Oil-Terminal Development

The Proposed Action includes one platform and 125 pipeline miles (212 kilometers). Fish inhabiting or transiting lower Cook Inlet could be subjected to offshore/onshore construction activities from the Proposal. These activities could cause disturbance to pelagic fish and displacement from their preferred habitat, as turbidity from this work increases. Positive effects may accrue as offshore structures attract and protect some species. Any disturbance or displacement should be short term (hours to days), limited to only the time of construction and shortly thereafter. Offshore construction also could temporarily disturb and/or displace fisheries resources. Any disturbance or displacement should be short term (hours to days), limited to only the time of construction and shortly thereafter. Noise and disturbance associated with pipeline construction could have temporary impacts on the behavior of beluga whales during the winter. However, available data indicate their use of such areas is low. In summer, belugas tend to be concentrated in the extreme upper inlet, and the Cook Inlet population of beluga whales has shared Cook Inlet with oil and gas exploration and development for years, with no apparent ill effects.

Overall, impacts on marine and coastal birds from development and production activities are limited to the effects of helicopter flights (abandonment of roosting or foraging areas, nest abandonment, and lowered reproductive success) on those relatively few nesting or roosting individuals directly under or in close proximity (a few hundred feet) to the flight path. These impacts could continue for 1-2 years if birds adapt to the flights, or continue for the life of the project if the birds fail to adapt. Airborne and underwater noise associated with development and production activities is the main source of disturbance of harbor seals and nonendangered cetaceans. Noise and disturbance would come from air (up to 78 helicopter-round-trip flights per month to the one platform during the height of development activities) and vessel traffic (up to 40 marine-supply-boat round trips per month), offshore pipeline laying (25 miles/40 kilometers), platform installation, and very local coastal habitat alteration at the pipeline landfall. These effects are estimated to be local (within about1 mile/1.6 kilometers of the traffic, platform, pipeline, and terminal activities) and short-term (less than 1 hour for air- and vessel-traffic-disturbance events to less than 1 year for pipeline- and platform-construction activities). Helicopter traffic to and from the one production platform is estimated to increase from 1.25-2.5 trips per day during the 4 years of exploration to 1.3-2.6 trips per day during the 3 years of development; marine-supply-boat traffic to and from the platform is estimated to increase from 0.6-1.25 trips per day during the 4 years of exploration to 0.666-1.3 trips per day (20-40 per month) during the 3 years of development. When nearshore, this traffic is estimated to increase the frequency of potential disturbance to bears and other terrestrial mammals along the traffic routes. However, disturbance events are estimated to be brief (a few minutes or less than 1 hour), and the displacement of bears and other terrestrial mammals is estimated to last for less than 1 hour, with no lasting effect on individual animals. The number of animals displaced is estimated to be few (such as 1-3 bears). Onshore, the construction of up to 75 miles (120 kilometers) of oil pipeline may be needed from the landfall along the anticipated pipeline corridors to existing production facilities at Nikiski. Approximately 5 miles (8 kilometers) of onshore gas pipeline would be constructed from the landfall to tie into the anticipated gas pipeline to Nikiski. This construction activity could temporarily displace some terrestrial mammals along the onshore pipeline route. Landfall development at the Anchor Point terminal could displace a small number of harbor seals, but no measurable effects are expected on local populations. Short-term (one season) and local (within ¼ mi) displacement effects of feeding and roosting birds are expected.

IV.B.1.l(3)(b) Effects of Oil Spills

A potential large spill would produce the possible loss of some adult demersal fishes and possible increased mortality of eggs and fry of pink salmon, semidemersal fishes, and demersal fishes, but no population-level changes would be estimated. No spill effects on beluga whales are estimated, because any potential spill would originate in lower Cook Inlet in offshore waters, quite distant from the preferred beluga whale habitat of coastal river mouths and their summer concentration in upper Cook Inlet. If beluga whales in Cook Inlet eventually recover from overhunting, it is possible this stock could again begin to use the lower inlet and there would be more overlap with activities associated with the Proposed Action (National Marine Fisheries Service, 2002),

http://www/fakr.noaa.gov/protectedspecies/whales/beluga/adn_articles/6_12_02_hunt.htm. More beluga whales, therefore, would become vulnerable to the effects of an oil spill. Impacts on marine and coastal birds could involve the loss of hundreds to possibly tens of thousands of birds from a large oil spill, depending on the timing and size of the spill. Depending on the number of birds lost and the species involved, recovery from these losses could require 1 year to two generations (from 2-4 years). Effects on marine mammals from a large spill are estimated to produce the loss of an estimated 20-100 harbor seals and a few fur seals. Total recovery from these losses is estimated to take place within 1 year to less than 5 years. Regional populations or migrant populations of nonendangered marine mammals are not estimated to be affected. As discussed under routine effects in Section IV.B.1.i - Terrestrial Mammals, the overall effect on terrestrial mammals is estimated to include the loss of an estimated 10 brown bears and fewer than 20 Sitka black-tailed deer from ingesting oil-contaminated food sources. Recovery of terrestrial mammal habitats are estimated to take more than 1 to perhaps 3 years for brown bears and 1 year for Sitka black-tailed deer. It is estimated that regional populations of brown bears, Sitka black-tailed deer, and other terrestrial mammals such as moose would not be affected by an oil spill.

The chance of one or more onshore pipeline spills occurring is 1.6%. The analysis is based on a spill size of 2,500 barrels. Such a spill is expected to have a minor effect on river otters, brown bears, and other terrestrial mammals along the onshore pipeline route. Perhaps a few individual river otters and brown bears could be exposed to the oil spills and be adversely affected, and minor-transient local habitat contamination could last from 1 to several years, depending spill-cleanup efforts. No effects are expected on marine mammals, because it is assumed to occur onshore and it is not likely to reach the marine environment. Nesting birds could suffer impacts for one breeding season.

IV.B.1.l(3)(b)1) Effects of Small Spills

Depending on their size, small spills may have effects on marine and coastal birds. Because a small amount of oil spreads out rapidly on the ocean surface to a thin sheen and has the tendency to break up into small patches and streamers, an oil spill has to be at least several barrels and possibly as many as 50 barrels before birds would be at risk. A limited number of birds also could be lost to small oil spills; recovery from small spills probably would require no more than 1 year. Small oil spills are estimated to have minor effects on harbor seals, other marine mammals, and terrestrial mammals with perhaps losses of a few individual harbor seals and a few individual river otters and brown bears due to oiling, and some minor, transient, and local contamination of coastal habitat lasting less than 1 year.

IV.B.1.l(3)(b)2) Effects of a Large Spill

A large spill (greater than or equal to 1,000 barrels) is unlikely to occur, based on a mean spill number of 0.16 spills for Alternative I for Sales 191 and 199. For purposes of analysis, one 1,500-barrel platform or one 4,600-barrel pipeline spill is assumed to occur under Alternative I and under the two deferral alternatives.

IV.B.1.l(3)(c) Site-Specific Oil-Spill Effects on Subsistence Resources

Under Alternative I for Sales 191 or 199, oil development is assumed to occur in the Cook Inlet Planning Area, with oil transported from one production platform through 25-mile (40 kilometers) oil and gas subsea pipelines to a landfall located on the Kenai Peninsula north of Kachemak Bay.

IV.B.1.l(3)(d) Conditional Probability Analysis

No oil spills are assumed to occur during exploration activities. For the development and production phase, a 1,500-barrel oil spill from a platform, or a 4,600-barrel oil spill from a pipeline, is assumed for purposes of analysis. The probabilities of either oil spill contacting specific environmental resource areas would be the same. The Oil-Spill-Risk Analysis estimates there is a 19% chance that one or more oil spills greater than or equal to 1,000 barrels could occur.

A 4,600-barrel oil spill could contact environmental-resource areas where important subsistence resources are present. The following discussion presents conditional and combined probabilities estimated by the Oil-Spill-Risk Analysis model (expressed as a percent chance) of an oil spill contacting subsistence-resource areas. Conditional probabilities are based on the assumption that an oil spill has occurred and makes contact. Combined probabilities, on the other hand, factor in the chance of the oil spill occurring.

Oil-spill contact in winter could affect hunting for caribou, moose, bear, and deer, and the harvest of sea mammals and shellfish. During summer, an oil spill would primarily affect fishing and whaling.

Upper Cook Inlet: For conditional probabilities, the oil-spill model estimates a 1-53% chance of a 4,600-barrel oil spill starting at LA1-LA7 and contacting Tyonek ERA 1 (Tuxedni Bay) within 30 days during the summer. There is a 1-70% chance of contact from P1-P6 within 30 days. Land segments 36 (Redoubt Point), 37 (Drift River), 39 (Seal River, Big River), and 40 (West Foreland), have a 1-9% chance of contact from a summer oil spill originating at LA1-LA5 for 30 days. From an oil spill originating at P1-P4, there is a 1-13% chance of contact for 30 days (see Figures III.C-18 and III.C-19).

Winter-contact percentages generally are less. For 30-days, the oil-spill model estimates a 1-49% chance of an oil spill that starts at LA1-LA5 to contact Tyonek ERA 1. Only LS 36 has a chance of contact within 30 days, ranging from 3-4% starting at LA1 and LA2. For 30 days, there is a 1-6% chance of contact from P1 and P2 (see Tables A.2-3, A.2-6, A.2-21, and A.2-24).

Central Kenai Peninsula: For conditional probabilities, LS 44 (Deep Creek, Ninilchik), and LS 45 (Cape Starichkof, Happy Valley) have a 1-6% chance of contact from a summer oil spill originating at LA1-LA5 within 30 days. From an oil spill originating at P1-P3, there is a 1-18% chance of contact within 30 days (see Figure III.C-20).

Winter-contact percentages generally are less. For 30-days, the oil-spill model estimates a 1-5% chance of an oil spill starting at LA1 and LA2 and contacting LS's 44 and 45. From an oil spill originating at P1-P3, there is a 1-14% chance of contact for 30 days (see Tables A.2-3, A.2-6, A.2-21, and A.2-24).

Lower Kenai Peninsula: For conditional probabilities, the oil-spill model estimates a 1-23% chance of a 4,600-barrel oil spill starting at LA1-LA7 and contacting Seldovia/Port Graham/Nanwalek ERA 31 (Kachemak Bay/outer Kenai Peninsula) within 30 days during the summer. There is a 1-8% chance of contact from P1-P6 within 30 days. Land segments 47 (Seldovia), 48 (Nanwalek, Port Graham), 49 (Elizabeth Island, Port Chatham, Koyuktolik Bay), 50 (Barren Islands, Ushagat Island), and 51 (Amatuli Cove, East Amatuli and West Amatuli Islands), have a 1-8% chance of contact from a summer oil spill originating at LA1-LA7 for 30 days. From an oil spill originating at P1-P6, there is a 1-5% chance of contact for 30 days (see Figure III.C-20).

Winter-contact percentages generally are less. For 30-days, the oil-spill model estimates a 19% chance of a spill starting at LA1-LA7 and contacting ERA 31. There is a 1-7% chance of contact from P1-P7 within 30 days. Land segments 47-51 have a chance of contact within 30 days, ranging from 1-5% starting at L1-L7. For 30 days, there is a 1-3% chance of contact from P1-P6 for these same land segments (see Tables A.2-3, A.2-6, A.2-21, and A.2-24).

Kodiak Island: For conditional probabilities, the oil-spill model estimates a 0-4% chance of a 4,600-barrel oil spill starting at LA1-LA7 and contacting Kodiak Island ERA's 10 (Kupreanof Strait), 13 (Middle Cape), and 19 (Twoheaded Island) within 30 days during the summer. There is a 0-8% chance of contact from P1-P6 within 30 days. Land segments 67-78 on the eastern shore of Kodiak and Afognak Islands and LS's 89-92 on the southwest shore of Kodiak Island all have less than a 0.5% chance of contact for 30 days for both summer and winter. Land segments 79 (Seal Bay, Tonki Bay), 80 (Andreon and Pernosa Bay, Big Fort Island), 81 (Shuyak Island), 82 (Blue Fox Bay, Shuyak Island, Shuyak Strait), 83 (Foul Bay, Paramanof Island), 84 (Malina Bay, Raspberry Island, Raspberry Strait), 85 (Kupreanof Strait, Viekoda Bay), 86 (Uganik Bay, Uganik Strait, Cape Ugat), 87 (Cape Kulik, Spiridon Bay, Uyak Bay), and 88 (Karluk Lagoon, Northeast Harbor, Karluk) have a 0-6% chance of contact from a summer oil spill originating at LA3-LA7 for 30 days. From an oil spill originating at P3-P6, there is a 1-6% chance of contact for 30 days (see Figures III.C-21 and III.C-22).

For 30-days, the oil-spill model estimates a 0-7% chance of a spill starting at LA1-LA7 and contacting ERA's 10, 13, and 19. There is a 0-8% chance of contact from P1-P6 within 30 days. Land segments 79-88 have a chance of contact within 30 days, ranging from 0%-6% starting at L1- L7. For 30 days, there is a 0%-6% chance of contact from P1-P6 for these same land segments (see Tables A,2-3, A,2-6, A,2-21, and A.2-24).

Southern Alaska Peninsula: For conditional probabilities, the oil-spill model estimates a 0% chance of a 4,600-barrel oil spill starting at LA1-LA7 and contacting the southern Alaska Peninsula ERA 15 (Chignik

Bay) within 30 days during the summer. There is a 0% chance of contact from P1-P6 within 30 days. Land segments 1-12 on the southern shore of the Alaska Peninsula all have less than a 0.5% chance of contact for 30 days for both summer and winter. Land segments 13 (Cape Providence, Chiginagak Bay), 14 (Agripina Bay, Aisiiak Island), and 15 (Cape Kanatak, Cape Kekurnoi, Bear Bay) have a 1% chance of contact from a summer oil spill originating at LA6 and LA7 for 30 days. From an oil spill originating at P6, there is a 1% chance of contact for 30 days (see Figures III.C-23 and III.C-24).

For 30-days, the oil-spill model estimates a 1% chance of a spill starting at LA7 and contacting ERA 15. There is a 1% chance of contact from P6 within 30 days. Land segments 13-15 have a chance of contact within 30 days, ranging from 1-2% starting at L4-L7. For 30 days, there is a 1-2% chance of contact from P4-P6 for these same land segments (see Tables A.2-3, A.2-6, A.2-21, and A.2-24).

IV.B.1.l(3)(e) Combined Probability Analysis

Combined probabilities express the percent chance of one or more oil spills greater than or equal to 1,000 barrels occurring and contacting a certain environmental-resource area over the production life of the lease sales. For combined probabilities, the oil-spill model estimates a 6% chance that an oil spill would occur from a platform or a pipeline and contact subsistence-specific ERA 1 (Tuxedni Bay), a 1% chance for ERA 31 (Kachemak Bay), and less than a 0.5% chance for ERA's 10 (Kupreanof Strait), 13 (Middle Cape), and 19 (Twoheaded Island) within 30 days (Table A.2-30). The conditional probabilities indicate the potential risk of oil-spill contact to subsistence-fishing resources and sites south of Tyonek.

IV.B.1.l(3)(f) Effects of Oil-Spill Cleanup Activities

Identified oil-spill-cleanup strategies potentially would be estimated to reduce the amount of spilled oil in the environment and tend to mitigate oil-spill-contamination effects. On the other hand, disturbance to subsistence resources would increase from oil-spill-cleanup activities. Offshore, skimmers, workboats, barges, aircraft overflights, and in situ burning during cleanup could displace beluga whales, other marine mammals, and terrestrial mammals, and force them to avoid areas where they normally are harvested or make them more wary and difficult to harvest. People and boats offshore, and people, support vehicles, and heavy equipment onshore, as well as any intentional hazing and capture of animals would disturb coastal resource habitat, displace subsistence species, alter or reduce subsistence-hunter access to these species, and alter or extend the normal subsistence hunt. Deflection of resources, resulting from the combination of a large oil spill and spill-response activities, could persist beyond the timeframe of a single season, perhaps lasting several years. Oil-spill-cleanup activities are estimated to be an additional impact, potentially causing displacement of the subsistence hunt, subsistence resources, and subsistence hunters (see Impact Assessment, Inc., 1998). Oil-spill cleanup would increase overall effects by displacing subsistence species, altering or reducing subsistence-hunter access, and altering or extending the normal period of the subsistence hunt. The result could be a major effect on subsistence harvests and subsistence users, who would suffer nutritional and cultural impacts.

IV.B.1.l(3)(g) Large Gas Releases

If a natural gas blowout occurred, with possible explosion and fire, subsistence resources (i.e., fish, birds, and beluga whales) in the immediate vicinity of the blowout could be killed, particularly if the explosion occurred below the water surface. Natural gas and gas condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. However, natural gas vapors and condensates would be dispersed very rapidly from the blowout site, and it is not estimated that these pollutants would affect any subsistence resources except individual animals present in the immediate vicinity of the blowout (the loss of probably fewer than 100 animals with such losses replaced within 1 year). For any resources to be exposed to high concentrations of gas vapors or condensates, the blowout would have to occur below or on the surface of the water and not from the top of the platform. The effects of natural gas development on subsistence resources are estimated to be short term (1 year or less) and local (within about 1 mile) of blowouts. Offshore gas blowouts and gas leaks are not estimated to have any effect on terrestrial mammals because the gas is estimated to disperse before reaching coastal habitats.

IV.B.1.l(4) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

If the scenario takes place exclusively as the result of Sale 199, the activities would be undertaken 2 years later (starting in 2006) but would not differ in location, duration, or magnitude. The actions would cause the same effects described for Sale 191, only 2 years later.

IV.B.1.l(5) Effectiveness of Mitigating Measures

Mitigating measures that would have the most effect on subsistence resources include Stipulation No. 1 - Protection of Fisheries, which directs the operators to avoid unreasonable conflicts to the fishing community, including the subsistence fishery. Stipulation No. 1 also provides for a review of the exploration plan and the development and production plan by subsistence communities. Stipulation No. 2 - Protection of Biological Resources provides for the protection of important biological populations and habitats by requiring surveys and the prevention of any adverse impacts if resource surveys identify special biological resources. Stipulation No. 3 - Orientation Program is designed to inform oil-patch employees about specific environmental and sociocultural concerns that relate to the lease sale areas. Any orientation program would provide information to workers in order to increase their sensitivity toward local community values, customs, and lifeways to avoid conflicts with traditional culture and subsistence pursuits.

Both ITL No. 1 - Bird and Marine Mammal Protection and ITL No. 2 - Information on Endangered and Threatened Species direct contractors to be aware of laws and treaties that protect these resources. These ITL clauses make clear the special concerns needed to be taken toward endangered and threatened species and inform contractors of the 1-mile horizontal and the 1,500-foot altitude distances recommended to protect important wildlife concentration areas. Beluga whales would be an important subsistence resource given particular attention under these ITL clauses. The ITL No. 3 - Sensitive Areas to be Considered in the Oil-Spill-Response Plans directs operators to pay special attention to specifically identified areas of biological concern when developing Oil-Spill-Response Plans. The ITL No. 3 instructs operators to identify important cultural sites and areas critical to subsistence resources and harvests in Oil-Spill-Response Plans and provide specific protective measures for these areas, specifically in regard to the use of dispersants in these special areas. The ITL No. 5 - Information on Oil-Spill-Response Preparedness makes sure that the Oil-Spill-Response Plan addresses, among other things, the location of appropriate oil-spill equipment and the ability of the operator to protect communities and important resources in case of an oil spill. The ITL No. 5 would provide special consideration in Oil-Spill-Response Plans for the protection of smaller, subsistence-based communities and their subsistence resources. The ITL No. 6 - Drilling Fluids and Cuttings Discharge during Post-Lease Activities advises the lessee that the Environmental Protection Agency prohibits the discharge of drilling fluids and cuttings into marine waters unless authorized by an approved National Pollution Discharge Elimination System permit. It advises the lessee to explore other methods for disposing of drilling discharges. The elimination of discharges into marine waters is a growing concern with local stakeholders, especially among regional subsistence hunters. Stipulations and ITL clauses are estimated to mitigate, although not eliminate, potential effects to subsistence resources and subsistence harvests and are not estimated to reduce the level of effects significantly.

IV.B.1.m. Effects of Sale 191 on Sociocultural Systems

This section examines the potential effects to sociocultural systems arising from routine operations and oil spills attributable to exploration, development, and production activities from Sale 191. The analysis examines effects from routine activities that may result from the sale, such as the introduction of industrial activities and changes in community population levels, potential effects on subsistence-harvest patterns, and effects from accidental oil spills and cleanup efforts and releases of natural gas. The section also examines differences in effects, if any, between Sales 191 and 199.

Significant effects will occur when chronic disruption of sociocultural systems occurs for a period of 2-5 years with a tendency toward the displacement of existing social patterns. Proper mitigation would reduce impacts somewhat during the life of the project. The affected activity or community would experience unavoidable disruptions to a degree beyond what is normally acceptable. Once the impacting agent is eliminated, the affected activity or community may retain measurable effects of the Proposed Action indefinitely, even if proper remedial action is taken.

IV. B.1.m(1) Conclusion

Exploration, development, and production activities, whether or not they are the result of Sale 191 or Sale 199, represent a continuation of an important, long-time economic characteristic of the area. The Proposed Action would not introduce qualitatively "new" activities to the area that alter existing sociocultural systems. Similarly, the relatively small number of new residents that come to the area because of the Proposed Action should not alter the existing sociocultural systems. Analysis identified no effects from routine operations or an unlikely natural gas release. We also found that while an unlikely large oil spill could affect subsistence-harvest resources, it would not result in long-term measurable effects or extreme contamination of subsistence-harvest resources. As such, the effects of an unlikely large oil spill do not displace or alter the fundamental long term relationship between subsistence harvest and sociocultural systems. The sociocultural systems of towns and, to a much lesser extent, cities that depend on commercial fishing could experience some short term adverse effects if an unlikely spill caused significant effects to commercial fishing.

IV.B.1.m(2) Effects from Exploration

This section examines the potential effects on sociocultural systems that may be caused by exploration activities using the description of the Proposed Action from Section II. Effects to sport fishing are analyzed in a Section IV.B.1.o.

The exploration phase of Sale 191 spans a 5-year period (2006-2010) during which two exploration wells and three delineation wells would be drilled from a single drilling platform. Support and logistic activities for the exploration phase are assumed to take place from existing air and marine facilities on the Kenai Peninsula. No additional support bases or industrial enclaves would be required.

The Section III characterization of cities and towns in the area shows that industrial activities associated with the exploration phase would not represent the introduction of new industrial activities on the Kenai Peninsula. Rather, such activities would represent a continuation of existing operations associated with the oil industry that currently are based on the Kenai Peninsula. As shown in Table IV.B-19, total sale-related employment associated with the exploration phase equals 40 jobs. Very little inmigration of workers should result from these levels of employment because of the reservoir of skilled petroleum-industry workers in the Kenai Peninsula Borough. Furthermore, the crew of the exploration rig normally is contracted with the vessel.

The operation of an exploration platform in lower Cook Inlet waters may be an unwelcome use for some residents, just as it may be a welcomed use in other parts of the inlet. For example, offshore platforms have become an accepted part of the offshore landscape in upper Cook Inlet for decades. Actions undertaken by residents to influence the scope and timing of the Proposed Action would occur within the general framework of the public policymaking in the cities, towns, and villages.

Effects on sociocultural systems from effects on subsistence harvests during the exploration phase should be minimal, because effects on subsistence harvests are not expected to create measurable changes in the availability or accessibility of subsistence resources.

IV. B.1.m(3) Effects from Development and Production

The development and production phase of Alternative I would extend for 24 years (2009-2033). During this time, one production platform would be installed, 50 miles of offshore pipeline and 75 miles of onshore pipeline would be laid, 60 production and service wells would be drilled, and an assumed total of 140 million barrels of oil and 190 billion cubic feet of natural gas would be produced. Before activities such as this can take place, however, a planning process ensues that largely involves the preparation of a development and production project EIS.

IV.B.1.m(3)(a) Routine Operations

Sociocultural effects from routine operations could be realized if employment from development and production causes an inmigration of people into the area that is beyond the capacity of the sociocultural systems or if subsistence-harvest activities or patterns are changed.

The majority of resident population generated by the scenario is assumed to reside within the Kenai Peninsula Borough. Table IV.B-20 shows a forecast of resident population for the Borough during the life of the project. Employment estimates, presented in Table IV.B-19 indicate total direct employment of 210 jobs from development and 70 jobs from production, with total employment at 330 jobs and 100 jobs, respectively. A number of factors reduce the number of people who would immigrate to the area as a result of this job creation. As with exploration, many of the jobs could be filled by Borough residents because of the reservoir of skilled petroleum-industry workers in the Kenai Peninsula Borough. Furthermore, because the Borough supports a large petroleum-services industry, a portion of the projected growth in population can be attributed to immigrants seeking employment in the industry, of which the development project will be a part. Finally, given the employment patterns related to commuting within the industry, some workers may reside outside the area and return home at the end of their shifts or contracted work assignments. Indirect and induced jobs, which are not necessarily in the petroleum-services sector, could provide additional opportunities for Borough residents. In any event, the increase in workers and their families brought to the area by the project would be small compared to the overall population increase. For example, at the height of development, approximately from 2010-2012, the project will create 300 jobs. Borough population is projected to increase by 1,651 persons during this time period.

The characteristics of the new segment of resident population should be compatible with the character of the central peninsula cities and towns where the new residents reside. The new segment should do little to change existing sociocultural patterns, because the character of activity and the social and cultural orientations of the persons expected to be involved should be compatible with the recent historical experience of the Borough’s communities.

IV.B.1.m(3)(b) Oil Spills

The MMS-sponsored research of the effects of the *Exxon Valdez* oil spill indicates that there are a wide range of potential impacts from an oil spill and that these effects may be realized at different levels, depending on the sociocultural characteristics of the community (Impact Assessment, Inc. 2001).

The sociocultural impacts of an oil spill to Native Alaskan communities (typically “villages” in the typology presented in Section III but are also sizeable components of some “towns”) are interconnected with the subsistence lifestyle of these communities. Subsistence embodies the traditions of Alaskan Native culture with overlapping connections to other cultural, social, and economic institutions. In addition, some effects may be felt well beyond the villages given the extended subsistence-food-distribution network to members in other places. The damage to natural resources used for subsistence may result in a disruption of the connections related to harvesting, processing, and sharing subsistence resources and cultural values and the meanings about these resources. The damage affects the essential connections between sociocultural factors of individual identity, social group, culture, and nature. In addition to the economic value of the lost resources, some of the other possible effects of a spill on Native communities include the following:

- contamination of resources, which creates unfamiliar conditions for subsistence hunters and fishers;
- change in cultural preferences for consumption of wild foods in Native diets;
- increased concerns about food safety and health;
- changes in traditional roles and status in the communities;
- disrupted transmission of cultural knowledge to children, which symbolizes continuation of Alaskan Native culture; and
- misunderstandings between outsiders and residents because of the different political structure of Alaskan Native villages.

As noted in the oil-spill analysis in Section IV.B.1.l, given the overarching importance of subsistence resources to the Alaskan Native communities, any significant impact to subsistence resources, whether actual or perceived, could create attendant significant impacts to the sociocultural systems of villages. While practices may be altered for a time by a 1,500 or 4,600 barrel oil spill and be further affected by cleanup, the conditions should last only a short time and not cause displacement of traditional practices.

In communities where commercial fishing is the basis of local economy (typically "towns" in the typology in Section III), the instrumental value of these fish resources organizes social institutions and ways of life. Subsistence may be an important activity in these communities, but it does not have the same meaning as in Alaskan Native communities. Oil spills that significantly damage the economic value of fishing resources may induce similar sociocultural effects in these communities through disruption of social institutions, social roles, patterns of life, and the economic viability of that lifestyle. The effect should be more acutely realized in communities where there is less diversification in commercial fishing. The effects of an oil spill may overwhelm the capacity of local governments to govern and deliver municipal services only in the event of significant impacts to commercial fishing, but would not fundamentally alter the essential functioning of government.

In communities with diversified economies or that are industrial centers (typically "cities" and their surrounding environs in the typology in Section III), use of natural resources is part of a larger mix of economic activity. These communities tend to have greater social resources than towns or villages. Sociocultural effects from an oil spill may be realized to the extent that resource damages significantly disrupt the economic connections between the sectors of cities. The instrumental, spiritual, or intrinsic values accorded the damaged resources are significant for how residents assess the significance of effects and long-term consequences of an oil spill. Effects in the larger cities tend to be from the "secondary effects" such as social disruptions related to inmigration and having attention of community leaders and institutions diverted from day-to-day business.

In any case, the effects of a 1,500-barrel platform or 4,600-barrel pipeline spill would be limited to a small area and would be of short duration. The spill should not cause significant effects to subsistence-harvest resources or commercial fishing. For cities, no measurable secondary effects are anticipated, because local resources should be sufficient to handle this unlikely event. As such, the spill should not cause an attendant significant effect to the sociocultural characteristics of Native Alaskan villages.

IV.B.1.m(3)(c) Large Natural Gas Release

We anticipate no disruption of the harvest of subsistence resources as a result of a large, one-day release of natural gas from the platform. In the event of a gas pipeline rupture, nonassociated activities would need to stay clear of the immediate vicinity during repair of the pipeline. Space-use conflict with subsistence-harvest activity or commercial fishing, if any, would be very limited. We anticipate no measurable or persistent effects to subsistence-harvest resources or commercial fishing and the associated sociocultural practice as a result of either circumstance.

IV.B.1.m(4) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

If the scenario takes place exclusively as the result of Sale 199, the activities would be undertaken 2 years later (starting in 2006) but would not differ in location, duration, or magnitude. The actions would cause the same effects described for Sale 191, only 2 years later.

IV.B.1.m(5) Effectiveness of Mitigation Measures

The Orientation Program stipulation may decrease potential misunderstandings by increasing awareness of historic and cultural values among workers on the project, Native Alaskans, and others in the area.

IV.B.1.n. Effects of Sale 191 on Recreation, Tourism, and Visual Resources

This section examines the potential effects to recreation, tourism, and visual resources arising from routine operations, natural gas releases, and oil spills attributable to exploration, development, and production activities from Sale 191. The section also examines any differences in effects, if any, between Sales 191 and 199. Section IV.B.1.o describes potential effects to sport fishing.

IV. B.1.n(1) Conclusion

The effects of routine exploration and development and production activities on private and commercial recreation and tourism arise from space-use conflicts. In the Cook Inlet area, these activities usually take place in different locations or at different times. When activities coincide, the duration normally will be very short. Routine exploration and development and production activities would not cause significant effects to visual resources, which would result if a rig can be seen and readily distinguished from public areas of high-scenic value, such as national and State parks, designated scenic areas, and similar locations. These effects can occur only if the rig is placed 5 miles (8 kilometers) or less from the coastline. An unlikely large oil spill could cause significant effects to coastal-dependent and coastal-enhanced recreation and tourism values limited to those areas where oil made contact and would last the duration of the cleanup. The Oil-Spill-Risk Analysis indicates that an oil spill contacting most land segments in recreation areas is unlikely or low. Effects to recreation, tourism, and visual resources are not expected from routine or accidental releases of natural gas.

IV.B.1.n(2) Effects from Exploration

This section examines the potential effects on recreation, tourism, and visual resources that may be caused by exploration activities using the description of the Proposed Action from Section II. Effects on sportfishing are analyzed in Section IV.B.1.o.

Recreation and tourism effects may result if exploration activities preempt or conflict with recreation use, especially during the peak recreation season, May through September. Significant effects on recreation would be realized if exploration or development and production activities cause:

- a complete displacement or closure of a nonfishing, coastal-dependent, or coastal-enhanced recreation facility, area, or activity for a short period during the peak season (5% of the peak season or approximately 7.5 days); or
- a partial closure of a nonfishing, coastal-dependent, or coastal-enhanced recreation facility, area, or use for a longer period, during the peak season (10% of the peak season or approximately 15 days).

Direct effects to recreation from exploration would be realized by coastal-dependent waterborne activities such as recreational marine boating and waterborne commercial marine wildlife viewing and sightseeing. Space-use conflicts could arise if vessels engaged in exploration activities, such as seismic-survey vessels, support vessels, and the drilling rig, cause private or commercial recreational users to divert from an area to avoid conflicts and there is no area nearby that offers similar amenities. In addition, effects would be realized if these vessels displaced recreational users from marine boating facilities and support services for which substitutes are not readily available. Indirect effects could be realized if exploration-related workers occupied lodging or campgrounds, displacing visitors in the process.

As described in Section III, nearly all coastal-dependent recreation and tourism activities in the Cook Inlet region take place in the nearshore area, especially in or adjacent to national and State parks or other special-use areas. On-lease exploration activities would occur far enough from these areas to avoid space-use conflicts. Some recreational marine boaters may have to avoid or navigate around vessels engaged in exploration. Facilities and operations would not be located so as to block access to navigable waters. The exploration rig may not be sited so as to obstruct navigable waters of Cook Inlet as determined by the U.S. Coast Guard. Few vessels will be engaged in exploration, minimizing the likelihood of displacing other users from marine-related facilities and services. While explicitly not applicable to nonfishing recreation use, the information generated by the Protection of Fisheries stipulation should help to further reduce potential space-use conflicts. Exploration activities would have no physical presence on land, and upland coastal-dependent and coastal-enhanced facilities and uses should not be affected. As such, natural gas releases during exploration should not appreciably affect recreation, tourism, and visual resources.

Exploration-related employment would not be large enough to induce inmigration of a sufficient number of people to displace pleasure visitors from lodging, campgrounds, or other facilities.

The evaluation of visual resource effects is somewhat more subjective, and individual perceptions vary. As a recent State of Alaska assessment of oil and gas activity in Cook Inlet notes:

> …while some may perceive the presence (of offshore structures) as intruders to scenic resources, others may not. It is clear that there is beauty in "pristine" vistas where there is a complete absence or perceived absence of human influence, and such vistas should be preserved for the benefit of society. However, aesthetic beauty also includes historical, cultural, and manmade influences on the natural world (State of Alaska, Dept. of Natural Resources, 1999).

The assessment also notes:

> …opinions regarding aesthetic quality vary widely, and the sight of a production platform in the Inlet, for example, may strike discord with some visitors, add to the allure for some, or result in passive indifference in others (State of Alaska, Dept. of Natural Resources, 1999).

Effects to visual resources may result from the presence of the drilling unit, if it creates a degree of change inconsistent with the existing view from designated scenic areas accessible to the public. In Cook Inlet, these areas tend to be communities, transportation corridors, and places where outdoor recreation and tourism take place such as national and State parks and reserves and areas meriting special attention. Several factors enter into the evaluation on the effect of offshore production platforms on visual quality. The visibility of an object depends on terrain and atmospheric conditions (Harman, O'Donnell, & Henniger Assocs., Inc., 1979). Research indicates that the distance from the viewer was found to be the most important characteristic to a viewer's response to offshore platforms (Kruger, Johnson, and Lee, 1991). Similarly, offshore structures are less noticeable when viewed against a backdrop of terrain than when viewed against a flat horizon. Generally, the addition of offshore structures results in some deterioration of visual quality. The effect of offshore facilities generally is less than the impact of onshore facilities, and a single OCS platform usually has the least effect (Granville Corporation, 1981).

Based on similar analyses of projects in other locations, the area of effect—the visual resource impact area—extends in a radius of 8 kilometers from the drilling unit. Beyond this distance, details of large objects such as the drilling unit are too small to be distinguished, large objects tend to become silhouettes, and objects tend to become part of the background and appear to the observer to be less obtrusive (Harman, O'Donnell, & Henniger Assocs., Inc., 1979; Granville Corporation, 1981; Continental Shelf Associates, Inc, 1995; USDOI, MMS Pacific Region, 2001).

While the exploratory drilling rig could be placed on any tract leased within the sale-area boundary, this analysis uses the Oil-Spill-Risk Analysis pipeline segments to define probable locations for the rig, terminating at the boundary of the proposed sale area. The visual resource impact area extends 8 kilometers (5 miles) around the pipeline segments. For this analysis, the visual resource impact area crosses the shoreline south of Anchor Point (Figure IV.A-2), encompassing a very small segment of the Kenai Peninsula including Anchor Point and a portion of the scenic Sterling Highway. However, this origin of the impact area is within the Cosmopolitan Unit on tracts currently under lease and, therefore, not part of the area considered for the Proposed Action. At no point does the visual resource impact area extend into Federal park or conservation units, State parks, or areas meriting special attention. The exploratory drilling rig would be in view of the passengers of aircraft flying nearby or vessels transiting the area. Depending on routing, existing offshore oil and gas structures also could be encountered.

IV. B.1.n(3) Effects from Development and Production

Using the description of the Proposed Action from Section II, the following section examines the potential effects on recreation, tourism, and visual resources that may be caused by routine development and production activities, natural gas releases, and small oil spills.

IV.B.1.n(3)(a) Routine Operations

Generally, effects to recreation and associated tourism from routine development and production activities result from the following:

- temporary changes in recreation and tourist activities or locations such as those caused by use of campground facilities by construction crews or by area closures or restricted access from offshore platform, pipeline, or onshore facility construction; or

- long-term change in recreation and tourist activities or locations, such as that caused by the presence of offshore or onshore infrastructure such as platforms, processing facilities, supply depots, and crew bases that may change use patterns.

A coastal-oriented recreation facility or use does not have to be precluded or completely degraded for an effect to be realized. A facility may remain opened, but the recreation quality may be diminished to the point that an effect occurs. However, three other factors that enter into the evaluation of effects are implicit in the determination. The first factor accounts for the degree to which substitutes for the activity or site do or do not exist and remain accessible and unaffected. The second factor recognizes that some activities that require additional training, skills, or special equipment (such as scuba diving, kayaking, and sailing) often have a higher associated value than other activities. The third factor recognizes that not all recreation and tourism that occurs in the coastal zone is necessarily coastal dependent or coastal enhanced.

Offshore construction will preclude the use of a section of the marine area by recreational users. During initial installation, a 1,600-meter (5249 feet) radius around the offshore platform defines the affected area because of high traffic and activity in the area. After initial installation, vessel traffic and noise will determine the affected area. For pipeline construction, a 600-meter (1,968-foot) radius around the installation vessel defines the affected area. The nominal rate of offshore pipeline installation is 1,600 meters (5,249 feet) per day; for onshore buried pipeline installation, 640 meter (2,100 feet) per day; and for onshore unburied pipeline, 320 meters (1,050 feet) per day. Offshore-to-onshore pipeline segment tie-in may take 5 days (Granville Corporation, 1981). As such, any space-use conflict between construction and recreation and tourism uses could be avoided or would last only for a short time. Natural gas releases from the platform are not expected to affect recreation and tourism areas and activities.

Regarding onshore infrastructure, no long-term effects are expected to occur. In another section, the EIS explains (see Section IV.B.1.s(3), especially IV.B.1.s(3)(d)), the many Statewide standards already in place for siting and approving energy-related facilities. These standards specify that facilities must be sited in areas of least biological productivity, diversity, and vulnerability and that areas of particular scenic, recreational, environmental, subsistence, and cultural values be protected. In the case of any new onshore pipelines, existing transportation and easement corridors must be used and utilities must be installed underground and out of sight wherever possible. The pipeline will also be designed, constructed, and maintained to minimize risk to fish and wildlife habitats from a spill, pipeline malfunction, or other construction activity. The processing of any recovered oil and gas is expected to take place at the facilities of existing industrial areas such as Nikiski.

Construction activities may cause some inmigration of workers into the Kenai Peninsula. Three factors would buffer the inmigration:

1. The Peninsula supports a well-developed petroleum-services industry; the local labor force should be able to satisfy much of the demand.
2. Slack resources may be available in the local labor force because of the seasonal nature of other employment on the Kenai Peninsula.
3. Commuter employment patterns in the petroleum industry mean that workers often leave the area at the end of their work periods to return home.

The residual transient work force may create demand for temporary housing, some of which could be satisfied by recreational campgrounds and other accommodations that serve visitors. During the off-peak season, approximately October to April, sufficient vacancies may exist to accommodate the demand caused by project construction workers without displacing pleasure visitors. The Kenai Peninsula Borough Coastal Management Program specifies methods of minimizing effects from development, including timing activities to reduce impacts resulting from large influxes of workers and using temporary work camps to house workers (Kenai Peninsula Borough, 1989).

As noted in the exploration analysis, several factors enter into the evaluation on the effect of offshore production platforms on visual quality. The visual resource impact area for production, an 8-kilometer radius around the platform, is the same as that for the exploration rig. As such, the visual impact for offshore structures from development and production is the same as for exploration. Natural gas releases from the platform are not expected to alter the overall visual aspects of the structures.

State of Alaska and Kenai Peninsula Borough coastal program policies require that activities which could conflict with the use of designated recreational areas be conducted to minimize effects and that facilities be sited to protect areas of particular scenic or recreational value. For example, to minimize effects, pipelines must be buried in areas of high scenic or recreational value, and existing facilities and pipeline routes must be used or consolidated when the infrastructure exists to satisfy the industrial requirement (Kenai Peninsula Borough, 1990).

IV.B.1.n(3)(b) Small Oil Spills

The potential installation of one offshore platform and associated pipeline facilities brings with them the possibility of offshore and onshore oil spills that could impact the shoreline recreational facilities in the area. Depending on the size and location and trajectory of a spill, some of the effects on coastal recreational resources might include:

- alteration in the use of recreational lands or waters, with disturbance to unique habitat and visual resources;
- reduction in the quality of recreational experiences due to changes in scenery, changes in wildlife behavior, or changes in visitor use patterns to the area; or
- change in administration and enforcement levels necessary to manage local recreation.

A small spill is defined as less than 1000 barrels. Most U.S. OCS spills less than 1,000 barrels usually are less than 50 barrels. In fact, 99% of all U.S. OCS spills have been less than or equal to 10 barrels in size. Spills less than 1,000 barrels would be more frequent during the production years, but the anticipated spill volumes still would be small. Based on the oil-spill scenario presented in Section IV.A.4, 99% of Cook Inlet spills for the proposed development would be less than 10 barrels with an average size of 0.13 barrels. Spills of this magnitude are not expected to make landfall or to impact shoreline recreational facilities.

IV.B.1.n(3)(c) Large Oil Spills

The effects to coastal-dependent and coastal-enhanced recreation and tourism from a large oil spill needs to be evaluated for three periods:

1. Closure - the period when the facility or access is officially closed for cleanup.
2. Physically degraded - the period when the facility is open or access is not restricted, but the experience is degraded because there is still evidence of pollution.
3. Perceptually degraded - the area is physically clean, yet the memory of the accident is fresh enough that the quality of the experience may be somewhat degraded (USDOI, MMS, Pacific Region, 2001).

Effects of a 1,500-barrel spill from a facility or 4,600-barrel spill from a pipeline would be very location specific and would vary depending on the time of year. Section IV.B.1.r identifies the national and State parks and other special areas that could be contacted by an oil spill.

A case study of a 3,100-barrel oil spill from the *Glacier Bay* in 1987 indicates that beach-cleanup activities around Cook Inlet lasted approximately 3 weeks. Beach-cleanup crews were dispatched to various locations at Kalgin Island, Clam Gulch, East Forelands, and Drift River. At some locations, cleanup was episodic, occurring with each subsequent report of oil or tarballs on the beach (Burden, 1990). Evidence from the case study suggests that intense cleanup activities at any location that would cause closure were short lived, on the order of a few days at most. From the time of initial cleanup to the end of operations, the areas affected could be physically or perceptually degraded.

We define effects as “significant” if an oil spill completely displaces or closes a nonfishing, coastal-dependent or coastal-enhanced recreation facility, area, or activity for a short period during the peak season (5% of the peak season or approximately 7.5 days) or causes a partial closure for a longer period (10% of the peak season or approximately 15 days). Summer is the peak season. As such, significant impacts to the coastal-dependent and coastal-enhanced recreation and tourism values of the affected area could result from the 1,500-barrel or 4.600-barrel spill if it occurred from May to September and cleanup exceeded the normative times listed above. The effects would be limited to these values and only for the duration of the cleanup. For example, oil contacting the coastline of Katmai National Park and Preserve and Lake Clark National Park would not degrade recreation and tourism in the interior portions of these parks.

As previously noted, oil spills are unlikely. The Oil-Spill Risk Analysis presented in Appendix A, Table A.2-14 (Summer) indicates the percent chance that a spill from a production facility (LA) or pipeline segment (P) in the project area would contact a particular land segment within 10 days, assuming such an unlikely spill occurs. The chance that an unlikely oil spill from a facility in LA4 through LA7 or from pipeline segments P4 through P7 would contact the coastline of Katmai National Park (LS's 19 through 27) ranges from 1-18%. The chance that an unlikely spill from a facility in LA1 through LA3 or pipeline segments P1 through P3 would contact the coastline of Lake Clark National Park and Reserve (LS's 33 through 36) ranges from 1-26%. The chance that an unlikely spill from a facility in LA1 and LA2 or pipeline segments P1 and P2 would contact recreation areas along the eastern Cook Inlet coastline from Clam Gulch to Anchor Point (LS's 42-46) ranges from 1-18%.

For other areas, the Oil-Spill-Risk Analysis indicates the chance that an unlikely facility or pipeline spill from anywhere offshore in the project area would contact recreation areas is low (a maximum 10% chance, usually much less) for the Alaska Peninsula National Wildlife Refuge (LS's 1-9), Aniakchak National Monument and Preserve (LS's 10 and 11), Becharof National Wildlife Refuge (LS's 12-18), Outer Kenai Peninsula (LS's 48-55) including the Barren Islands (LS's 50 and 51), and Kodiak National Wildlife Refuge (LS's 89-92).

The potential impact of onshore pipeline spills on recreation and visual resources is considered to be small. Section IV.A.4 estimates the risk at 1.6%. Such spills would be contained onsite or cleaned up without important long-term impacts.

IV.B.1.n(3)(c) Large Natural Gas Releases

A large, 1-day release of natural gas from the platform would require that recreational vessels avoid the immediate area of the platform during the event. Nonassociated vessels would need to stay clear of the immediate vicinity of the pipeline repair for the duration of the activity. We anticipate no space-use conflict as a result of either circumstance.

IV.B.1.n(4) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

If the scenario takes place exclusively as the result of Sale 199, the activities would be undertaken 2 years later (starting in 2006) but would not differ in location, duration, or magnitude. The actions would cause the same effects described for Sale 191, but 2 years later.

IV.B.1.n(5) Effectiveness of Mitigation Measures

The stipulations would not affect the impacts to visual resources. The information developed by the Protection of Fisheries stipulation could reduce potential conflicts with nonfishing recreation and tourism. ITL No. 3 - Sensitive Areas to be Considered in Oil-Spill-Response Plans lists areas, such as national parks, for which lessees have the primary responsibility to provide specific protective measures. The ITL clause is effective to the extent that these measures provide protection to the attendant recreation values of the areas from an unlikely oil spill. Geographic response strategies developed by Cook Inlet Spill Prevention and Response, Inc., call for protective measures to be implemented at many heavily used recreation sites in the Cook Inlet to prevent or minimize potential contamination from an oil spill.

IV.B.1.o. Effects of Sale 191 on Sport Fishing

IV.B.1.o(1) Conclusion

We estimate the following effects on sport fisheries from Alternative I for Sale 191. An unlikely oil spill could contact land segments along the western side of the Kenai Peninsula, which would limit the ability of sport halibut and salmon fishers from setting out from oiled locations, as long as such locations were oiled. The fishers could use alternate locations, but some of the charter operators would lose business. The loss of business could be 20%, or $6 million in 2000 dollars for 1 year Oil contacting the beaches could affect clam gathering, particularly for razor clams and other types of clams along the east and west side of Cook

Inlet and mussels and steamer clams in small bays off of Kachemak Bay. In any area contacted by oil, populations of the intertidal organisms could be depressed measurably for about a year, and small amounts of oil likely would persist in the shoreline sediments for more than a decade, a significant impact. Disturbance, displacement, or injury as a result of drilling or seismic activities likely would not be measurable. We estimate the various effects to sport fisheries taken altogether would not cause population-level changes in sport fisheries resources and, consequently, in sport fisheries activities. We anticipate no effects from the release of 5-10 million cubic feet of natural gas during exploration or 10 million cubic feet during development.

IV.B.1.o(2) Effects from Exploration

We anticipate no effects from routine activities including disturbances, discharges, noise, and small oil spills (less than 1,000 barrels). We anticipate that sport fishing would not be affected by geophysical surveys, well drilling, helicopter flights, supply-boat trips, and pipeline construction. The effects of routine activities on sport fisheries are the same as for those on fisheries resources in general. See Section IV.B.1.d - Fisheries Resources for a more detailed analysis. Also, the effects of routine activities on sport fisheries are the same as for those on lower trophic-level organisms in general. See Section IV.B.1.c - Lower Trophic-Level Organisms for a more detailed analysis. We anticipate no effects from the release of 5-10 million cubic feet of natural gas during exploration. We assume the gas would disperse into the air without burning.

IV.B.1.o(3) Effects from Development and Production

IV.B.1.o(3)(a) Routine Operations

We do not anticipate effects on sport fishing from routine operations, including geophysical surveys, well drilling, helicopter flights, supply-boat trips, pipeline construction, and small oil spills. Small spills of less than 1,000 barrels are described in Appendix A-1. The effects of routine activities on sport fisheries are the same as for those on fisheries resources in general. See Section IV.B.1.d – Fisheries Resources for a more detailed analysis. Also, the effects of routine activities on sport fisheries are the same as for those on lower trophic-level organisms in general. See Section IV.B.1.c - Lower Trophic-Level Organisms for a more detailed analysis. Small natural gas releases would not affect sport fisheries.

IV.B.1.o(3)(b) Large Oil Spills

There is a 19% probability of one or more offshore spills of 1,000 barrels or greater from the Proposed Action. We anticipate some effects from potential spills greater than 1,000 barrels (1,500 barrels or 4,600 barrels). The Oil-Spill-Risk Analysis shows some probability of spilled oil contacting land segments along the western side of the Kenai Peninsula, which would limit the ability of sport halibut and salmon fishers from setting out from oiled locations, as long as such locations were oiled. The fishers could use alternate locations, but some of the charter operators would lose business. Many of the charter operators use tractors to launch their boats from the shallow beaches. The loss of business could be $6 million in 2000 dollars if the loss was 20% (Herrmann, Todd, and Hamel, 2001). Oil contacting the beaches could affect clam gathering. People gather razor clams (S*iliqua patula*) and other clams (for example, *Myra* spp. and *Macoma balthica*) for sport along the east and west sides of Cook Inlet and mussels and steamer clams in small bays off of Kachemak Bay. As described in Section IV.B.1.c(1), in any area contacted by oil, populations of the intertidal organisms would be depressed measurably for about a year, and small amounts of oil would persist in the shoreline sediments for more than a decade. The difference between large spills and small spills is in area. A large onshore oil spill of 2,500 barrels is assumed. Because this is onshore, we assume no effect on sport fishing.

IV.B.1.o(3)(b)1) Effects on Charter Boat Operators and Other Salmon and Halibut Fishers

The conclusion regarding sport fishers for halibut and salmon is based on the growth of the charter businesses north of Homer along the west side of the Kenai Peninsula. These charter operations use tractors to launch their boats. Oil on the beach would restrict this method of boat launching. If the charter operations were based only out of the Homer Spit harbor, our conclusions would be different. In 1987, at the time of the *Glacier Bay* oil spill, nearly all sport halibut and salmon charter boats s used the port in

Homer. A report on the July 2, 1987, *Glacier Bay* tanker oil spill states that the oil spill had "no measurable impacts" on sportfishing (Northern Economics, 1990). The *Glacier Bay* was in transit from Valdez to the Kenai pipeline facilities when it is assumed to have hit an uncharted rock approximately 20 miles west of the Kasilof River. The Alaska Department of Environmental Conservation estimated that the *Glacier Bay* spilled 3,100 barrels of oil, based on calculations of oil unaccounted for when, on July 5, 1987, it completed unloading oil at the Kenai pipeline facilities (Northern Economics, 1990). For purposes of analysis, we assume that a spill of 3,100 barrels of oil is within the range of 4,600 barrels of oil; therefore, the effects of the *Glacier Bay* oil spill would approximate the effects of a spill as much as 4,600 barrels. The location of the *Glacier Bay* oil spill is within the area of projected spill sites. The *Glacier Bay* oil spill does not cover all these sites, but it does provide an actual oil-spill example for analytical purposes.

The waters of Cook Inlet and Kachemak Bay and the rivers and streams flowing into Cook Inlet account for a large proportion of the total sport-fishing effort for the entire State. At the time the *Glacier Bay* oil spill occurred (July 2), several popular sport fisheries had taken place. The early runs of Kenai River chinook (king) salmon, Russian River sockeye (red) salmon, Kasilof River chinook (king) salmon, and lower Kenai Peninsula (i.e., Deep Creek, Ninilchik Creek, Anchor River, Homer Spit, and Halibut Lagoon) salmon were over. However, on July 2, the most popular sport fisheries were just beginning. The halibut charter-boat fishery receives the largest number of clients during July and August. The second-run Kenai salmon fishery was just beginning with constant activity through the month of July. The silver salmon fisheries on all rivers and streams on the Kenai Peninsula do not begin until the latter part of July and run through September and even later.

Northern Economics (1990) did not find evidence of losses in these sport fisheries due to oil-fouled boats or gear, loss of fishing opportunity, or harvest of oil-fouled fish that had to be discarded (with only one exception). Also, none of the fishing groups that Northern Economics contacted had legal claims for damages resulting from the *Glacier Bay* oil spill.

When Northern Economics began its study of the *Glacier Bay* oil spill, it was anticipated that the spill would affect the halibut fishery in Cook Inlet the most. The 1987 president of the Homer Charterboat Association indicated that the spill did not impact the halibut charter-boat fleet operating out of Homer. Time and area closures did not apply to halibut charters; oil did not foul the operators' boats or gear or affect the numbers of fish caught; and customers did not cancel reservations because of concerns about the spill. Several individual charter-boat operators validated the response of the president of the Association. Halibut charters do not typically fish the riptide areas where the oil seemed to accumulate, thus avoiding oil in various parts of Cook Inlet. One operator from Ninilchik reported no impacts but stated that he had to maneuver away from oil to keep it off the boats (Northern Economics, 1990).

An oil spill could result in closure of ports in Homer, Kenai, and elsewhere along the west side of the Kenai Peninsula. Ports probably would be closed to protect the port and vessels from being oiled. Oil spills potentially can cause economic losses to boat owners and fishers by contaminating fishing gear and vessels. Oiled vessels would need to be cleaned and oiled gear either cleaned or replaced. We anticipate that fishers would fish alternate areas because of these port closures. Charter operators would avoid going out of port into Cook Inlet to avoid fouling their gear and vessels. Public perception of oil-spill damage, real or perceived, would diminish the number of sport fishers. Sport fishers likely would target alternate fishing grounds until the quality of the fishing experience, real or perceived, in the oil-spill area returned to the previous conditions. However, none of this occurred for the sport fishery during the *Glacier Bay* oil spill.

IV.B.1.o(3)(b)2) Effects on Fish

Fish can accumulate hydrocarbons from contaminated food; however, this is a temporary effect, because fish metabolize hydrocarbons and can excrete both metabolites and parent hydrocarbons from the gills and the liver (National Research Council, 1985).

IV.B.1.o(3)(b)3) Effects on Clam Gatherers

People gather razor clams (S*iliqua patula*) and other clams (for example, *Myra* spp. and *Macoma balthica*) for sport along the east and west sides of Cook Inlet. People also gather mussels and steamer clams in small bays off of Kachemak Bay. Effects on the gathering would correspond to the effects on the species. Oil contacting the beaches could affect the clam gathering. In any area contacted by oil, populations of the intertidal organisms would be depressed measurably for about a year, and small amounts of oil would persist in the shoreline sediments for more than a decade. For effects on these species, see Section IV.B.1.c - Effects of Sale 191 on Lower Trophic-Level Organisms. Oil spills greater than 1,000 barrels (1,500 barrels or 4,600 barrels) could contact land segments on the western side of Cook Inlet (LS's 28-37), Kalgin Island (LS 38), and the western shore of the Kenai Peninsula (LS's 42-46) in the summer (Table A.2-15). As shown in Table A.2-15, for many land segments, the probabilities of an oil spill will contact a certain land segment within 30 days in the summer are as low as 1; the highest is 27 for Chisik Island and Tuxedni Bay.

The saltwater sport fishery in Cook Inlet, freshwater sport fishery on the Kenai Peninsula, and clamming on the shores of Cook Inlet are an important part of the overall economy. For more information on effects on the economy of the Kenai Peninsula Borough, see Section IV.B.1.j. Sport fisheries also are an important part of recreation and tourism. For more information on the effects on recreation and tourism, see Section IV.B.1.n. For more information on effects on national and State parks, which also are integral to the sport-fisheries industry, see Section IV.B.1.r.

IV.B.1.o(3)(c) Large Gas Releases

We anticipate no effects from the release of 10 million cubic feet of natural gas during production. In the event of a blowoutg, we assume the gas would disperse into the air without burning. The amount of work to repair the gas well after a blowout would be minimal.

IV.B.1.o(4) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

If the scenario takes place exclusively as the result of Sale 199, the activities would be undertaken 2 years later (starting in 2006) but would not differ in location, duration, or magnitude. The actions would cause the same effects described for Sale 191, only 2 years later.

IV.B.1.o(5) Effectiveness of Mitigating Measures

The most effective mitigating measures for fisheries resource and, in turn, sport fisheries is Stipulation No. 1 - Protection of Fisheries (see Section II.F). With this mitigating measure in place, the effects from Alternative I on sport fisheries likely would be minimized. To the degree that this mitigation measure is implemented, fisheries resources likely would benefit; however, its absence is not expected to substantially increase adverse effects. Mitigation for sport fisheries possibly would include cleaning beaches affected by oil spills, booming off small harbors where sport-fishing boats anchor, and booming off bays where people collect clams and mussels. Cleaning sandy beaches such as those along the west side of the Kenai Peninsula would be more problematic.

IV.B.1.p. Effects of Sale 191 on Environmental Justice

Environmental Justice is an initiative that culminated with the February 11, 1994, Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* and an accompanying Presidential memorandum. The Executive Order directs each Federal Agency to consider environmental justice part of its mission. Its intent is to promote fair treatment of people of all races, so no person or group of people shoulders a disproportionate share of the negative environmental effects from this country's domestic and foreign programs. Specifically, the Executive Order requires an evaluation in the EIS as to whether the proposed project would have "disproportionately high adverse human health and environmental effects…on minority populations and low income populations." The following analysis follows the guidance of the Executive Order on how to determine resident minority or low-income populations in the project area and establishes the criteria for determining effects (see also Section III.C.7 - Environmental Justice). Potential Environmental Justice impacts of proposed Sale 191 on low-income, minority populations in the Cook Inlet/Shelikof Strait area focus on the Native, subsistence-based communities of the region. Potential effects from noise, disturbance, and oil spills could produce Environmental Justice effects on these communities because of their reliance on subsistence foods and because effects may affect subsistence resources, subsistence-harvest practices, and sociocultural systems.

Oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health. The MMS believes that serious mitigation for such impacts begins with a commitment to preventing spills in the first place by employing the highest standards for exploration, development, and production technology.

IV.B.1.p(1) Conclusion

Potential effects would focus on the Native minority populations residing in the subsistence-based communities of upper Cook Inlet (Tyonek); the central Kenai Peninsula (Ninilchik and the Kenaitze Indian population in Kenai); the lower Kenai Peninsula (Seldovia, Nanwalek, and Port Graham); Kodiak Island (Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions); and the southern Alaska Peninsula (Chignik, Chignik Lagoon, Chignik Lake, Ivanof Bay, and Perryville). Noise and disturbance from routine activities are not estimated to produce Environmental Justice impacts. The likelihood of a large spill occurring and affecting subsistence resources and harvest areas is very small; nevertheless, in the unlikely event that a large oil spill occurred and contaminated essential resources and harvest areas, major effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Such impacts would be considered disproportionately high adverse effects on Alaskan Natives. Any potential effects to subsistence resources and subsistence harvests from a large oil spill are estimated to be mitigated, though not eliminated, to some extent. Effects from an unlikely large oil spill would not be considered a high adverse impact to non-Native, low-income areas.

IV.B.1.p(2) Race

Minority, low-income populations in the Kenai Peninsula, Kodiak Island, and the Lake and Peninsula Boroughs are relevant to the Environmental Justice analysis. The 2000 Census counted 49,695 persons resident in the Kenai Peninsula Borough; of these 3,713 identified themselves as American Indian and Alaska Native for a 7.5% indigenous population. Population counts for the 2000 Census for subsistence-based communities in the borough are Tyonek with 193 residents and a 95.3% American Indian and Alaskan Native population; Ninilchik, 772 residents with a 14.0% indigenous population; Kenai, 6,942 residents with a 12.10% indigenous population (the Kenaitze Indian population); Seldovia City, 286 residents with a 17.5% indigenous population; Seldovia Village, 144 residents with a 36.8% indigenous population; Nanwalek, 177 residents with an 89.3% indigenous population; and Port Graham, 171 residents with an 84.8% indigenous population (see Figures III.C-18, III.C-19, and III.C-20). The 2000 Census counted 13,913 in the Kodiak Island Borough, with 2,028 (14.6%) identifying themselves as American Indian and Alaskan Native; the Filipino population of 2,016 (14.5%) represented another large minority in the Borough. Population counts for the 2000 Census for subsistence-based communities in the Borough are Akhiok with 80 residents and an 86.3% American Indian and Alaskan Native population; Karluk, 27 residents with a 96.3% indigenous population; Larsen Bay, 115 residents with a 78.3% indigenous population; Old Harbor, 237 residents with a 73.0% indigenous population; Ouzinkie, 225 residents with an 80.9% indigenous population; and Port Lions, 256 residents with a 63.3% indigenous population (see Figures III.C-21 and III.C-22). The 2000 Census counted 1,823 persons resident in the Lake and Peninsula Borough; 1,340 identified themselves as American Indian and Alaskan Native for a 73.5% indigenous population. Population counts for the 2000 Census for subsistence-based communities in the Borough are Chignik, with 79 residents and a 60.8% American Indian and Alaskan Native population; Chignik Lagoon, 103 residents with an 81.6% indigenous population; Chignik Lake, 145 residents with an 86.9% indigenous population; Ivanof Bay, 22 residents with an 95.5% indigenous population; and Perryville, 107 residents with an 97.2% indigenous population (USDOC, Bureau of the Census, 2000; Figures III.C-22 and III.C-24).

One definition of "minority population communities" includes areas where the minority population ranges from 50-100%. Percent minority population figures were taken from the 2000 Census Tiger files. The definition for a minority population is based on the Council on Environmental Quality's 1997 guidance that defines minority population as exceeding 50% of the population of the affected area. In most cases, unless otherwise specified, we are assuming the affected area is a community and the percent minority population is a measure of the minority population of that community. Figure IV.B-1 shows the areas identified by the 2000 Census Tiger files that meet this criterion. However, embedded within census-designated places may be distinct Native Alaskan villages, such as Seldovia Village and Ninilchik, that constitute recognized minority Native communities but do not register 50% or greater because of the demographic characteristics of the majority population in these places. As noted by Table III.C-10, these villages have a high degree of reliance on subsistence resources as an economic base, have a predominant Native culture, a significant Native population, and exhibit a high degree of kinship and tribal organization. In other words, they exhibit the same characteristics as the areas that have a majority minority population. Therefore, in our analysis, we address the areas that have a 50% or greater minority population or that constitute a recognized Alaskan Native village (See Appendix A-1, Oil-Spill Information, Models, and Assumptions and specifically Sections C.1.a-d for an explanation of Oil-Spill-Risk Analysis land segments).

There are no significant "other minorities" in the aforementioned potentially affected subsistence-based communities. American Indian and Alaskan Native minority populations are the only minority populations allowed to conduct subsistence hunts for marine mammals. "Other minorities" are not allowed to participate in subsistence marine mammal hunts and do not constitute a potentially affected minority population.

IV.B.1.p(3) Income

According to the Department of Commerce, the U.S. median household income in 2000 was $42,148, and the median household income for the State of Alaska in 2000 was $50,746. The criteria used to determine low income communities in the Cook Inlet Planning Area was based on 2000 Census data that determined that the median household income for the State of Alaska. Any median income that fell below this threshold for any community was considered low income. In 1998, the average U.S. per-capita income was $27,203 and the State of Alaska per-capita income was $27,835.

In the Kenai Peninsula Borough, the 2000 Census recorded a median household income of $46,397, a median family income of $54,106, and a per-capita income of $20,949; 971 families (7.6%) and 4,861 individuals (10.0% of the Borough's population) were at or below the poverty level. In Tyonek, the median household income was $26,667, the median family income was $29,792, and the per-capita income was $11,261; 29 people (13.9%) in the community were at or below the poverty level. Respective median household income, median family income, per-capita income figures, and number of people (and percent of community population) in poverty for the other subsistence-based communities in the Borough were as shown in Table IV.B-22.

In the Kodiak Island Borough, the 2000 Census recorded a median household income of $54,636, a median family income of $58,834, and a per-capita income of $22,195; 151 families (4.6%) and 901 individuals (6.6% of the Borough's population) were at or below the poverty level. Respective median household income, median family income, per-capita income figures, and number of people (and percent of community population) in poverty for the other subsistence-based communities in the Borough are detailed in Table IV.B-22.

In the Lake and Peninsula Borough, the 2000 Census recorded a median household income of $36,442, a median family income of $42,312, and a per-capita income of $15,361; 62 families (14.8%) and 342 individuals (10.0% of the Borough's population) were at or below the poverty level. Respective median household income, median family income, per-capita income figures, and number of people (and percent of community population) in poverty for the other subsistence-based communities in the Borough were as shown in Table IV.B-22.

The U.S. average median household income in 2000 was $42,148, and the U.S. average per-capita income was $29,469. The Alaska average median household income in 2000 was $50,746, and the Alaska average per-capita income was $29,642. The average median household income ($46,397) and the average per-capita income ($27,235) in the Kenai Peninsula Borough were below the State and national averages. The median household and per-capita incomes of all subsistence-based communities in the Borough were below the State and national averages. The average median household income ($54,636) was above the State and national averages, but the average per-capita income ($26,818) in the Kodiak Island Borough was below the State and national averages. The median household incomes of all subsistence-based communities except Ouzinkie ($52,500) were below the State and national averages; per-capita incomes of all subsistence–based communities in the Borough were below the State and national averages. The average median household income ($36,442) and the average per-capita income ($15,361) in the Lake and

Peninsula Borough were below State and national averages. The median household incomes in the subsistence–based communities of Chignik, and Chignik Lake were all below State and national averages, but household incomes for Chignik Lagoon, Ivanof Bay, and Perryville were above these averages. Per-capita incomes in all five subsistence-based communities were below the State and national averages. In the Kenai Peninsula Borough, 29.5% of the average family incomes fell in the low- to very-low-income category. In the Kodiak Island Borough, this number ran to 24.1%, and in the Lake and Peninsula Borough, the percentage of low- to very-low income families jumped to 38.7%. Poverty-level thresholds were based on the U.S. Bureau of the Census, Census 2000 Survey; low income is defined by the U.S. Census Bureau as 125% of poverty level (USDOC, Bureau of the Census, 2000, 2002).

Subsistence-based communities in the region qualify based on their racial/ethnic minority definitions alone. Nevertheless, the aforementioned figures indicate that low income also commonly correlates with Native subsistence-based communities in the region (see Figure IV.B-2). The communities of Tyonek, Seldovia Village, Nanwalek, and Port Graham all fall below the household median income threshold of $42,650 for low income for the Kenai Peninsula Borough. Akhiok, Karluk, Larsen Bay, Old Harbor, and Port Lions fall below the household median income threshold of $46,500 for low income for the Kodiak Island Borough, and Chignik Lagoon falls below the household median income threshold of $40,100 for low income for the Lake and Peninsula Borough.

The 2000 Census Tiger files identify six nonsubsistence-based coastal communities on the Kenai Peninsula with median household incomes that fall below the low-income threshold. Any 2000 median household income in the Kenai Peninsula Borough below $42,650 is considered low income (based on a family of four, see U.S. Department of Housing and Urban Development, 2002). These communities and their 2000 median household incomes are Cohoe - $38,542; Clam Gulch - $37,500; Ninilchik - $36,250; Happy Valley - $30,139; Nikolaevsk - $37,500; and Fox River - $26,964. As shown in Figure IV.B-2, most of these areas are located between the cities of Kenai (which includes Soldotna and Nikiski) and Homer, that is, the area shown on the figure where median household income ranges from $15,000-$40,250. Table III.C-13 indicates that the Kenai area with its diverse economy provides a number of employment opportunities for Cohoe, Clam Gulch, Ninilchik (which includes a Native village), and Happy Valley. Homer provides employment opportunities for Nikolaevsk while a portion of the residents lead a self-sufficient lifestyle in a distinct community. These places have mostly non-Native populations and are generally oriented toward Kenai. Light manufacturing takes place in Fox River, which is oriented toward the City of Homer. Some commercial fishing takes place in these communities. Overall, Homer is the center of commercial fishing on the Kenai Peninsula, while Kenai is the center for sport fishing.

The onshore segments of the oil industry are located primarily in the Kenai/Nikiski area, some distance away from the low-income areas listed above. All activities associated with exploration, development, and production from the Proposed Action are estimated to stage out of Kenai/Nikiski. Processing of crude oil and natural gas would take place at existing processing facilities in the Kenai/Nikiski area. Most of the employment created by the Proposed Action would be centered in Kenai/Nikiski area, which currently provides employment opportunities for four of the low-income areas listed above. The analysis of effects from the Proposed Action, Section IV.B.1 and Table II.B-2, identified no significant impacts from routine operations from exploration, development, and production. Therefore, because of the geographic distribution of the industry and the lack of effects identified in the analysis, routine operations would not have a disproportionate affect on the low-income areas. That is, because geographical patterns of the oil and gas industry in Cook Inlet do not follow the residential distribution of low-income or minority populations in the Inlet; i.e., development does not concentrate where low-income or minority populations reside.

For an unlikely large oil spill, the Oil-Spill-Risk Analysis conditional probabilities for land segments (shown on Figure IV.B-2) that contain these communities—LS's 43 (Clam Gulch, Kasilof), 44 (Deep Creek, Ninilchik), and 45 (Cape Starichkof, Happy Valley)—have a relatively higher percent chance of contact with a 1-6% chance of contact from a summer oil spill originating at LA1–LA5 for 30 days. From an oil spill originating at P1-P3, there is a 1-18% chance of contact for 30 days, assuming such an unlikely spill occurs. The winter-contact percentages for 30 days are similar to summer with a 1-6% chance of an oil spill starting at LA1, LA2, and LA5. From an oil spill originating at P1-P3, there is a 2-14% chance of contact for 30 days (see Tables A.2-3, A.2-6, A.2-21, and A.2-24 in the Oil-Spill-Risk Analysis in Appendix A).

Potentially, the coastal areas of low-income communities identified in the 2000 Census Tiger files shown on Figure IV.B-2 could have a greater chance of being contacted by accidental oil spills originating from Sale 191 activities. The analysis of effects from the Proposed Action, Section IV.B.1 and Table II.B-2, indicate an unlikely large oil spill may significantly affect commercial fishing if the fishery is closed primarily from contamination concerns, and sport fishing and recreation/tourism for the duration of the cleanup. The fact that oil-spill conditional probabilities indicate a relatively higher percentage chance of contact in the low-income areas does not constitute a disproportionate high adverse effect, primarily because residents of these communities would be estimated to experience effects similar to the majority of residents in the Kenai Peninsula Borough living in the cities of Kenai and Homer and the surrounding areas.

IV.B.1.p(4) Consumption of Fish and Game

Subsistence has been defined as "an activity performed in support of the basic beliefs and nutritional needs of the residents…and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities" (State of Alaska, Dept. of Natural Resources, 1997). This definition gives only a glimpse of the importance of the practice of the subsistence way of life in Alaska Native culture, but it does underscore that it is a primary cultural and nutritional activity on which Native residents of the region depend. For a more complete discussion of subsistence and its cultural and nutritional importance, see Section III.C.3 - Subsistence-Harvest Patterns. For statements of the traditional importance of subsistence practices, see Native traditional knowledge commentary in Sections IV.B.1.1 - Subsistence-Harvest Patterns and IV.B.1.m - Sociocultural Systems. See also the Cumulative Effects and Affected Environment sections for these resources for more traditional knowledge.

Potential effects focus on the Native, subsistence-based communities of the Cook Inlet/Shelikof Strait region. The sociocultural and subsistence activities of these Native communities could be affected by accidental oil spills. Possible oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health. Interestingly, after the *Exxon Valdez* oil spill, in 1989-1994, testing of subsistence foods for hydrocarbon contamination revealed very low concentrations of petroleum hydrocarbons in most subsistence foods. In fact, the Food and Drug Administration concluded that eating food with such low levels of hydrocarbons posed no significant risk to human health (Hom et al., 1999). The Food and Drug Administration recommended avoiding shellfish, which accumulates hydrocarbons. Human health could be threatened in areas affected by oil spills; however, we can reduce these risks through providing timely warnings about spills, providing forecasts about which areas may be affected, and even evacuating people and avoiding marine and terrestrial foods that may be affected. Federal and State agencies with health care responsibilities would have to sample the food sources and test for possible contamination.

Whether subsistence users will use potentially tainted foods is entirely another question that involves cultural "confidence" in the purity of these foods. Based on surveys and findings in studies of the *Exxon Valdez* oil spill, Natives in affected communities largely avoided subsistence foods as long as the oil remained in the environment. Perceptions of food tainting and avoiding use remained (and remain today) in Native communities after the *Exxon Valdez* oil spill, even when agency testing maintained that consumption posed no risk to human health (State of Alaska, Dept. of Fish and Game, 1995; Hom et al., 1999; Burwell, 1999).

The ability to assess and communicate the safety of subsistence resources following an oil spill is a continuing challenge to health and natural resource managers. After the *Exxon Valdez* oil spill, analytical testing and rigorous reporting procedures to get results out to local subsistence users were never completely convincing to most subsistence users about the safety of their food because scientific conclusions often were not consistent with Native perceptions about environmental health. According to Peacock and Field (1999), a discussion of subsistence-food issues must be cross-disciplinary, reflecting a spectrum of disciplines from toxicology, to marine biology, to cultural anthropology, to cross-cultural communication, to ultimately understanding disparate cultural definitions of risk perception itself. Any effective discussion of subsistence-resource contamination must understand the conflicting scientific paradigms of Western science and traditional knowledge in addition to the vocabulary of the social sciences in reference to observations throughout the collection, evaluation, and reporting process. True restoration of environmental damage, according to Picou and Gill (1996), "must include the reestablishment of a social equilibrium between the biophysical environment and the human community." Since 1995, subsistence restoration resulting from the *Exxon Valdez* oil spill has improved by the *Exxon Valdez* Trustee Council taking a more comprehensive approach involving partnerships with local communities that link scientific methodologies with traditional knowledge (Fall et al., 1999; Fall and Utermohle, 1999; Field et al., 1999; Nighswander and Peacock, 1999).

IV.B.1.p(5) Summary of Human Health Effects

The Council on Environmental Quality in its Environmental Justice guidelines tasks agencies to consider potential human-health effects by examining "relevant public health data and industry data concerning the potential for multiple or cumulative exposure to human health or environmental hazards in the affected population and historical patterns of exposure to environmental hazards, to the extent such information is reasonably available."

Concern about the impacts of oil-production activities on the marine water quality of Cook Inlet has grown ever since the discovery of oil in Cook Inlet in 1957. The passage of the Clean Water Act in 1972 and, more recently, the *Exxon Valdez* oil spill and the Oil Pollution Act of 1990 solidified these concerns and spurred water-quality research efforts being conducted in Cook Inlet. In the Cook Inlet/Shelikof Strait region, concerns about chemical contaminants have been a primary concern ever since the *Exxon Valdez* oil spill in 1989. Contamination of subsistence foods was a major concern after the spill and today, with subsistence-harvest levels in the region having returned to prespill levels, subsistence-resources users remain concerned about risks for contaminants, particularly from drilling discharges from nearshore and offshore Cook Inlet/Shelikof Strait exploration and production platforms (see Section IV.B.1.a - Effects on Water Quality).

Studies generally indicate that discharges of produced waters, muds, and cuttings have not significantly degraded Cook Inlet water quality or the health of its dependent resources, and discharge restrictions on new facilities are required by the NPDES permit process. Overall, the cumulative effect of these discharges on the Cook Inlet marine environment is estimated to have been insignificant.

Studies since 1976 have sampled sediments and biota for the presence of hydrocarbons and other contaminants. In a study by Shaw and Lotspeich (1977), the predominant source of hydrocarbons found in sediments and mussel tissues was determined to be biogenic. In 1991, the National Toxics Campaign Fund provided a chemical analysis of Cook Inlet sediments near the mouth of Drift River and within Trading Bay. Samples were tested for polycyclic aromatic hydrocarbons and metals, including beryllium, arsenic, and barium, and polycyclic aromatic hydrocarbons greater than or equal to 0.3 parts per million were not detected in any of the samples. A 1993 MMS study tried to establish baseline information on petroleum hydrocarbon occurrence, naturally occurring radioactive materials, and trace metals in Cook Inlet. The research concluded that physical, chemical, and bioassay results showed that Cook Inlet had very low environmental concentrations of hydrocarbons and that sediments and water were generally free from toxicity. No immediate evidence of heavy metal pollution in Cook Inlet was found (State of Alaska, Dept. of Natural Resources, 1999; UAA, ENRI, 1995). The Cook Inlet Regional Citizens' Advisory Council initiated an environmental study for Cook Inlet in 1993 to find out if oil-industry operations in Cook Inlet were having adverse effects on the ecosystem. Water, sediment, and bivalve samples were collected and analyzed. Researchers concluded that accumulation patterns indicated "a low-level background input of hydrocarbons of a source apparently not linked to the Trading Bay produced water discharge." Petroleum hydrocarbons levels in sampled sediments and shellfish tissues were below levels that could cause adverse biological effects in most marine organisms; in addition, these levels were characteristic of an uncontaminated coastal and offshore environment (State of Alaska, Dept. of Natural Resources, 1999; Arthur D. Little, Inc., 1995a).

In 1995, the Cook Inlet Regional Citizens' Advisory Council conducted a monitoring study that complemented earlier work. Hydrocarbon concentrations in sediments from all 1995 program stations were considerably lower than amounts estimated to cause adverse effects in animals, and the study's chemical analysis of halibut indicated a level of exposure to hydrocarbons that was comparable to areas considered uncontaminated (State of Alaska, Dept. of Natural Resources, 1999; Kinnetic Laboratories, Inc., 1996b). Findings revealed that concentrations of metals and petroleum-related compounds present in Shelikof Strait and outer Cook Inlet were not linked to oil and gas development in upper Cook Inlet or the

Exxon Valdez oil spill. The study concluded that the residue that is present originates from a combination of natural sources, such as river runoff, eroded coal or rock, and natural seeps. In addition, the concentrations in the sediments do not pose a significant risk to the environment. The study also found that the concentrations, composition, and sources of contaminants in the study area had not increased significantly since oil and gas development began in Cook Inlet in 1963.

In 1996, the MMS contracted for a 3-year monitoring study of sediment quality in Shelikof Strait and outermost Cook Inlet. The study examined whether there has been an accumulation of biologically significant levels of pollutants in depositional areas downcurrent of Cook Inlet development. This study confirmed the findings of earlier MMS studies that had looked for but did not find oil-industry contaminants in Cook Inlet waters or sediments. Concentrations of metals and organics (polycyclic aromatic hydrocarbons) in sediments in outermost Cook Inlet and Shelikof Strait had not increased significantly over the past 25-50 years. Overall, in terms of risk to biota and the benthic environment, the study provided a picture of contaminants and potentially toxic trace substances in the environment at very low concentrations with an attendant low biological risk (USDOI, MMS, 2001; State of Alaska, Dept. of Natural Resources, 1999; Arthur D. Little and EVS Environmental Consultants, 1999).

In 1998, the Cook Inlet Regional Citizens' Advisory Council, at a public meeting in Kenai, Alaska, presented a synthesis and evaluation of monitoring data from their 1993-97 environmental monitoring program. The program concluded that: (1) Sediments showed extremely low levels of polycyclic aromatic hydrocarbons. The sources of these hydrocarbons were varied and mixed and could not be attributed to Cook Inlet oil and gas development operations. There was no evidence of *Exxon Valdez* oil or Alaska North Slope oil in any of the subtidal sediments sampled, including sediments of Shelikof Strait. (2) Subtidal organisms had not accumulated or been exposed to high levels of hydrocarbons from Cook Inlet oil and gas activities. Minimal exposure to petroleum products by intertidal organisms had occurred in some instances (Littoral Ecological & Environmental Services, 1998). Overall results of the Cook Inlet Regional Citizens' Advisory Council monitoring program concurred with other pollution studies of Cook Inlet: contaminant levels, regardless of their source; pollutants in sediments; and tissues are at background levels or are undetectable and do not pose a threat to Cook Inlet biota (State of Alaska, Dept. of Natural Resources, 1999).

A 2001 study conducted by the National Oceanic and Atmospheric Administration and the National Institute of Standards and Technology looking for polychlorinated biphenyls in Cook Inlet beluga whales concluded that Cook Inlet belugas had much lower concentrations of polychlorinated biphenyls and chlorinated pesticides than belugas sampled in the Beaufort and Eastern Chukchi seas (Becker et al., 2001).

In response to concerns in the Cook Inlet region that subsistence food resources were being contaminated, the Environmental Protection Agency also initiated a pollution study for Cook Inlet in 1997. The study was conducted specifically to provide information to characterize potential human health risks associated with exposure to contaminants detected in subsistence food items harvested from Cook Inlet by members of four Alaskan subsistence villages: Tyonek, Seldovia, Port Graham, and Nanwalek. The study looked for dioxins, pesticides and polychlorinated biphenyls that might enter the Inlet through runoff from urban sources as well as production platforms. More than 100 samples of subsistence fish, shellfish, and marine plants were tested for dioxins/furans, polycyclic aromatic hydrocarbons, pesticides, polychlorinated biphenyls, and metals including inorganic arsenic, barium, cadmium, chromium, methyl mercury, and selenium. Preliminary results indicated that contaminant levels in fish and plants were some of the lowest ever detected by the Environmental Protection Agency. Several groups of chemicals (dioxins/furans, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons) were rarely detected. For almost every contaminant tested by the Environmental Protection Agency, concentrations were either completely nondetectable or were below levels of concern. Chemical concentrations for fish (chum salmon, sockeye salmon, cod, flounder, and halibut), invertebrates (mussel, butter clam, large clam, blue mussel, steamer clam), and plants (goose tongue, kelp, seaweed) were below levels of potential concern (Environmental Protection Agency, 1998; State of Alaska, Dept. of Natural Resources, 1999).

Laboratory results showed three contaminants in several food items at concentrations that might pose a health risk to people who eat them. Polychlorinated biphenyls and traces of mercury were found in sea bass, but "[t]he concentrations of polychlorinated biphenyl's and methyl mercury are very low relative to what's been found in other studies elsewhere, and are at or below typical background levels." Cadmium, which was detected in snails, chitons, and octopus, was estimated to be attributable to natural glacial deposits. The Environmental Protection Agency is determining whether the cadmium concentrations reflect background concentrations or are elevated due to human activity. These contaminants may pose a slight health risk to humans depending on how much is eaten, how often it is consumed, and how the food is prepared. The draft report concluded that "based on the comparative results, Cook Inlet harvested sea foods are nutritionally sound and contaminant concentrations generally appear to be lower than or within the range of other sea foods and commercial foods. Concentrations of total polycyclic aromatic hydrocarbons and dioxin-like polychlorinated biphenyls; however, appear to be higher than comparison data" (Environmental Protection Agency, 2001; State of Alaska, Dept. of Natural Resources, 1999).

Other initiatives researching contaminants in subsistence foods include a 1999 report by the Alaska Native Health Board: *Alaska Pollution Issues.* After assessing the risks from radionuclides, persistent organic pollutants, heavy metals, polychlorinated biphenyls, dioxins, and furans, the Health Board report concluded that the "benefits of a traditional food diet far outweigh the relative risks posed by the consumption of small amounts of contaminants in traditional foods" (Alaska Native Health Board, 1999). A 1998 report, *Use of Traditional Foods in a Healthy Diet in Alaska: Risks in Perspective*, by the Alaska Department of Health and Social Services essentially came to the same conclusion as the Native Health Board report. It did suggest that Alaska has a critical need to examine human biomarkers of polychlorinated biphenyl exposure and that more studies on polychlorinated biphenyl concentrations in the serum of Alaska Natives is needed. Such information would be the most relevant in determining polychlorinated biphenyl exposure through the subsistence food chain. A comprehensive Statewide screening study was advocated (Egeland, Feyk, and Middaugh, 1998).

In 2001, The Alaska Native Health Board put out the *Alaska Pollution Issues Update* report. The report was the first real attempt in Alaska to combine contaminant levels in subsistence foods, actual subsistence food consumption levels by Alaska Natives, and Food and Drug Administration and the Environmental Protection Agency action levels in order to come up with actual health advisories. Its overall conclusion was that:

> a small number of traditional foods contain contaminants with concentrations that are over the Food and Drug Administration action level, but most have levels below the action level. With the wide margin built in, for establishing the Food and Drug Administration action level, the results should be reassuring to consumers of traditional foods. To determine definitively if these low levels are harmful only ongoing research that measures contaminant levels in Native populations will provide the answer (Alaska Native Health Board, 2002).

IV.B.1.p(5)(a) Detailed History of Human Health Research in the Cook Inlet Region

The Council on Environmental Quality in its Environmental Justice guidelines tasks agencies to consider potential human health effects by examining "relevant public health data and industry data concerning the potential for multiple or cumulative exposure to human health or environmental hazards in the affected population and historical patterns of exposure to environmental hazards, to the extent such information is reasonably available." The guidance goes on to state that "agencies should consider these multiple, or cumulative effects, even if certain effects are not within the control or subject to the discretion of the agency proposing the action" (Council of Environmental Quality, 1997).

Disproportionate, high-adverse human-health effects—such as bodily impairment, infirmity, illness, or death—are determined by (1) whether health effects measured in risks and rates are significant (as defined by NEPA) or above generally accepted norms; (2) whether the risk or rate of hazard exposure by a minority, low-income population or Indian or Native tribe to an environmental hazard is significant and appreciably exceeds or is likely to exceed the risk or rate to the general population; and (3) whether health effects occur in minority populations affected by cumulative or multiple adverse exposures from environmental hazards.

In the Cook Inlet/Shelikof Strait region, concerns about chemical contaminants have been a primary concern ever since the *Exxon Valdez* oil spill in 1989. Contamination of subsistence foods was a major concern after the spill, and today, with subsistence-harvest levels in the region having returned to prespill levels, subsistence-resources users remain concerned about risks for contaminants, particularly from drilling discharges from nearshore and offshore Cook Inlet/Shelikof Strait exploration and production platforms (see previous discussion).

As authorized by the Environmental Protection Agency in its NPDES permit, some drilling muds and cuttings and other nonhazardous wastes are discharged into Cook Inlet. With the exception of mixing zones adjacent to drilling sites, monitoring results generally indicate that, because of conditions that produce rapid settling and dilution, marine discharges do not cause harmful effects in the water column.

Upper Cook Inlet is a dynamic, high-energy marine environment. Normal tidal change averages 10 feet near the mouth of Cook Inlet to approximately 30 feet (9 meters) at Anchorage. Tidal currents up to 8 knots (15 kilometers per hour) are common off the Forelands. Vertically, Cook Inlet waters are well mixed because of the speed and strength of these tidal currents. A southward tidal trend flushes water out of upper Cook Inlet (Arthur D. Little Co., Inc., 1991). For this reason, discharges from platforms are diluted rapidly in the marine environment; in addition, modeling generally has revealed that produced water effluents are diluted rapidly to concentrations that pose no risk of acute or chronic toxicity at the edge of the mixing zones. Dissolved and suspended-solid materials discharged from the platforms are diluted and transported with suspended glacial sediments through lower Cook Inlet into Shelikof Strait and the OCS of the Gulf of Alaska (State of Alaska, Dept. of Natural Resources, 1999; Arthur D. Little Co., Inc., 1991).

Studies indicate that discharges of produced waters, muds, and cuttings have not significantly degraded Cook Inlet water quality or the health of its dependent resources, and discharge restrictions on new facilities are required by the NPDES permit process. Overall, the cumulative effect of these discharges on the Cook Inlet marine environment is estimated to have been insignificant.

Concern about the impacts of oil-production activities on the marine water quality of Cook Inlet has grown ever since the discovery of oil in Cook Inlet in 1957. The passage of the Clean Water Act in 1972 and, more recently, the *Exxon Valdez* oil spill and the Oil Pollution Act of 1990 solidified these concerns and spurred water quality efforts being conducted in Cook Inlet.

Burrell (1978), in 1976, investigated baseline minerals present in suspended solids on OCS locations that included sites in Cook Inlet. A University of Alaska Fairbanks study was conducted the same year (Shaw and Lotspeich, 1977). Samples were collected and analyzed by a contractor for Greenpeace Alaska in 1991 on Drift River and Trading Bay sediments (National Toxics Campaign Fund, 1991). The MMS conducted a water- and sediment-quality assessment in preparation for an OCS lease sale in 1993. A water and benthic sediment quality study began that same year under the direction of the Cook Inlet Regional Citizen's Advisory Council. Other studies are currently under way, and results are forthcoming (State of Alaska, Dept. of Natural Resources, 1999; UAA, ENRI, 1995).

Most studies look for acute or chronic levels of key indicator compounds—heavy metals and hydrocarbons—in sediments and marine life. Filter-feeding bivalves accumulate toxins in their tissues. Researchers test the tissues of animals after being exposed to the water column. They look for variability in these levels between sampling stations. Chemical analysis includes the detection of polycyclic aromatic hydrocarbons, which leave a unique and traceable signature (State of Alaska, Dept. of Natural Resources, 1999).

Upper Cook Inlet bottom- and suspended-sediments composition differs from lower Cook Inlet due to different supply sources: glacial river systems to the north and the Gulf of Alaska current to the south. The four major river systems—the Susitna, the Matanuska, the Knik, and the Beluga—contribute about 70% to 80% of the freshwater that enters Cook Inlet (UAA, ENRI, 1995). Upper Cook Inlet waters have higher concentrations of suspended particulate matter, principally glacial rock flour, due to dynamic tidal mixing and the high sediment loads of rivers. Suspended-particulate matter concentrations range from 100 parts per million near the Forelands to 1 part per million near the inlet entrance (State of Alaska, Dept. of Natural Resources, 1999; USDOI, MMS, Alaska OCS Region, 1995).

Industrial discharges of metals from oil and gas facilities and runoff from the city of Anchorage include zinc, barium, cadmium, and mercury. These mineral discharges are monitored at known point sources, including oil-production facilities, the Point Woronzof Wastewater Treatment Plant, military bases, fish processors, and municipalities. Natural levels of these minerals also occur. Hydrocarbons are discharged into the inlet by streams and rivers as a result of the erosion of sedimentary rocks containing coal and from natural seeps (USDOI, MMS, Alaska OCS Region, 1995). Hydrocarbons from point discharges and nonpoint sources (i.e., runoff) also enter the inlet throughout the Cook Inlet basin (State of Alaska, Dept. of Natural Resources, 1999).

In 1976, researchers with the University of Alaska, Institute of Marine Science conducted a study looking for hydrocarbons in the biota and sediments of Cook Inlet. Seaweed, bivalve, and sediment samples were collected from sites in Mud, Dogfish, and Kasitsna bays and near the mouth of the Douglas River. Biogenic hydrocarbons were detected in sediments at all sampling sites. Differences in sediment grain size explained the variability in hydrocarbon levels between sites. Analysis of the seaweeds (*Fucus sp.* and *Macoma sp.)* indicated the presence of biogenic lipid source hydrocarbons, and variability between sites was attributed to species diet. None of the plant samples showed evidence of petroleum, and any hydrocarbons present appeared to be the products of metabolism (Shaw and Lotspeich, 1977). Analysis of mussel tissues (*Mytilus sp.)* from Mud Bay, adjacent to the Homer Spit, did show low concentrations of hydrocarbons characteristic of weathered petroleum although the predominate source of hydrocarbons in these mussel tissue samples was biogenic (State of Alaska, Dept. of Natural Resources, 1999; Shaw and Lotspeich, 1977).

A 1991 report was prepared for Greenpeace Alaska by the National Toxics Campaign Fund that provided a chemical analysis of Cook Inlet sediments. Sediments were collected in July 1991 near the mouth of Drift River and within Trading Bay. Samples were tested for polycyclic aromatic hydrocarbons and metals, including beryllium, arsenic, and barium. Polycyclic aromatic hydrocarbons greater than or equal to 0.3 parts per million were not detected in any of the samples. No beryllium or arsenic was detected although higher than average concentrations of barium were detected in all samples. The Trading Bay samples had levels of barium that were twice those of samples collected from Drift River (State of Alaska, Dept. of Natural Resources, 1999; National Toxics Campaign Fund, 1991).

A 1993 MMS study tried to establish baseline information on petroleum hydrocarbon occurrence, naturally occurring radioactive materials, and trace metals in Cook Inlet. Seawater, sediments, and biota were collected for chemical and biological analysis. Samples were taken in the vicinity of petroleum production in upper Cook Inlet and in Kachemak and Kamishak bays. These sites had been sampled previously by the MMS during the Outer Continental Shelf Environmental Assessment Program in the late 1970's. Although metals concentrations in suspended sediments appeared to be higher 17 years after the National Oceanic and Atmospheric Administration study by Burrell et al. (1978), the detection efficiency of modern analytical methods was much higher than that used by Burrell et al. (State of Alaska, Dept. of Natural Resources, 1999; UAA, ENRI, 1995). Concentrations of cadmium, copper, and zinc in mussel tissues were nearly identical to the levels found in 1977. Terrestrial-source concentrations of mercury were reported at sampling stations in the Upper Inlet that were higher than the Environmental Protection Agency designated chronic level (0.025 micrograms per liter), but were still below the acute toxicity level. The research concluded that physical, chemical, and bioassay results showed that Cook Inlet had very low environmental concentrations of hydrocarbons and that sediments and water were generally free from toxicity. No immediate evidence of heavy metal pollution in Cook Inlet was found (State of Alaska, Dept. of Natural Resources, 1999; UAA, ENRI, 1995).

Invoking the Oil Pollution Act of 1990, the Cook Inlet Regional Citizens' Advisory Council initiated an environmental study for Cook Inlet in 1993. The intent of the study was to find out if oil industry operations in Cook Inlet were having adverse effects on the ecosystem, and if so, to document pollution sources, magnitude, and distribution patterns (Arthur D. Little, Inc., 1995a). Water, sediment, and bivalve samples were collected and analyzed. Hydrocarbon collector devices and blue mussels were used to assess hydrocarbon concentrations in the water column. Clams from Kamishak and Kachemak bays were collected to establish a baseline level of hydrocarbons occurring in their tissue. Just as for the 1993 MMS study, sample sites were located near possible point sources of pollution, such as the produced-water outfall in Trading Bay (State of Alaska, Dept. of Natural Resources, 1999).

Analysis of the mussels and hydrocarbon collector devices showed some accumulation of hydrocarbons from the water column. The clams essentially were free of polycyclic aromatic hydrocarbons. Researchers concluded that accumulation patterns indicated "a low-level background input of hydrocarbons of a source apparently not linked to the Trading Bay produced water discharge" (Arthur D. Little, Inc., 1995a). Petroleum hydrocarbon levels in sampled sediments and shellfish tissues were below levels that could cause adverse biological effects in most marine organisms; moreover, these levels were characteristic of an uncontaminated coastal and offshore environment (State of Alaska, Dept. of Natural Resources, 1999; Arthur D. Little, Inc., 1995a).

Sampling conducted in 1994 produced similar results. Polycyclic aromatic hydrocarbon concentrations in most sediment samples were characteristic of naturally occurring hydrocarbons and representative of background or baseline levels. Sediments throughout the sampling area contained low levels of hydrocarbons, and their toxicity to sediment dwelling organisms did vary, with higher toxicity in lower inlet samples, particularly samples from Kachemak Bay. Curiously, toxicity was not due to hydrocarbon levels in the sediment and might have been due to the presence of compounds and substances not measured in the study, such as metals, naturally occurring inorganic compounds or municipal wastes (State of Alaska, Dept. of Natural Resources, 1999; Arthur D. Little, Inc., 1995b).

In 1995, the Cook Inlet Regional Citizens' Advisory Council conducted a monitoring study that complemented earlier work. Marine water, sediment, and halibut samples were collected and tested for hydrocarbons. Samples were taken from Trading Bay, the East Forelands, Kachemak Bay, Kamishak Bay, and near the Barren Islands. Results of the 1995 sampling program were similar to previous years. Hydrocarbon concentrations in sediments from all 1995 program stations were considerably lower than amounts estimated to cause adverse effects in animals (State of Alaska, Dept. of Natural Resources, 1999; Kinnetic Laboratories, Inc., 1996b).

The study's chemical analysis of halibut indicated a level of exposure to hydrocarbons that was comparable to areas considered uncontaminated (Kinnetic Laboratories, Inc., 1996b). No significant changes in metals, polycyclic aromatic hydrocarbons, and toxicity ranges in the 3 years of sampling were found. Some anomalies did occur with hydrocarbon levels in manmade collectors in Trading Bay higher than collectors positioned in Kachemak Bay and the East Forelands (Kinnetic Laboratories, Inc., 1996b; State of Alaska, Dept. of Natural Resources, 1999). Cook Inlet Keeper issued a report titled *The State of the Inlet* in 1997 that surveyed the range of pollution sources that could affect Cook Inlet water quality. The report identified risks posed by the region's rapidly growing human population and risks from urbanization. The Cook Inlet Keeper report stated that fish and sediment studies conducted to date that had sampled for hydrocarbon pollution had been inconclusive and that longer-term testing was needed before firm conclusions could be reached. In response to its own report, Cook Inlet Keeper initiated a citizen-based water quality sampling program (Cook Inlet Keeper, 1997; State of Alaska, Dept. of Natural Resources, 1999). In 1996, the MMS contracted for a 3-year monitoring study of sediment quality in depositional areas of Shelikof Strait and outermost Cook Inlet. Sampling for the $1.5 million 3-year study began in 1997. The study examined whether there has been an accumulation of biologically significant levels of pollutants in depositional areas down current of Cook Inlet development. The study, titled, *Sediment Quality in Depositional Areas of Shelikof Strait and Outermost Cook Inlet* and conducted by Arthur D. Little, was published in 2001 and concluded that contaminants are not linked to oil and gas development in upper Cook Inlet or the *Exxon Valdez* oil spill.

The study looked for hydrocarbon and trace-metal contaminants from oil-industry activity in areas with fine-grained sediments in Cook Inlet and Shelikof Strait. Contaminants will adsorb onto fine-grained material in the water and would be estimated to end up where fine-grained sediments are accumulating.

Samples were taken from sites in Cook Inlet and Shelikof Strait with additional sampling stations in the Gulf of Alaska to provide "upstream" source material. The study evaluated the amount of petroleum-related compounds and other metals present in sediment, sediment cores, fish tissue, and source samples. Findings revealed that concentrations of metals and petroleum-related compounds present today in Shelikof Strait and outer Cook Inlet are not linked to oil and gas development in upper Cook Inlet or the *Exxon Valdez* oil spill. The study concluded that the residue that is present originates from a combination of natural sources, such as river runoff, eroded coal or rock, and natural seeps. In addition, the concentrations in the sediments do not pose a significant risk to the environment.

The study also found that the concentrations, composition, and sources of contaminants in the study area had not increased significantly since oil and gas development began in Cook Inlet in 1963. Interestingly, sampling showed that some 10-20% of the total sediment deposited in the study area came from the Copper River. The study's findings were consistent with those of the recent draft Environmental Protection Agency report on contaminant levels in Cook Inlet subsistence foods. That study also found low levels of oil industry contaminants. This recent MMS study confirms and extends the findings of earlier MMS studies that had looked for but also did not find oil-industry contaminants in Cook Inlet waters or sediments. Concentrations of metals and organics (polycyclic aromatic hydrocarbons) in sediments in outermost Cook Inlet and Shelikof Strait have not increased significantly over the past 25-50 years; however, elevated mercury concentrations were identified in Kachemak Bay but suggest that the concentrations are typical for the region. Overall, in terms of risk to biota and the benthic environment, the study provided a picture of contaminants and potentially toxic trace substances in the environment at very low concentrations with an attendant low biological risk (USDOI, MMS, 2001; State of Alaska, Dept. of Natural Resources, 1999; Arthur D. Little, Inc., 1998).

In response to concerns that subsistence food resources are being contaminated, the Environmental Protection Agency also initiated a pollution study for Cook Inlet in 1997. The study was conducted specifically to provide information to characterize potential human health risks associated with exposure to contaminants detected in subsistence food items harvested from Cook Inlet by members of four Alaskan subsistence villages: Tyonek, Seldovia, Port Graham, and Nanwalek. The study looked for dioxins, pesticides, and polychlorinated biphenyls that might enter Cook Inlet through runoff from urban sources as well as production platforms. The study concentrated on species harvested for subsistence. Sampling was conducted between May and midsummer 1997. More than 100 samples of subsistence fish, shellfish, and marine plants were tested for dioxins/furans; polycyclic aromatic hydrocarbons; pesticides; polychlorinated biphenyls; and metals including inorganic arsenic, barium, cadmium, chromium, methyl mercury, and selenium (State of Alaska, Dept. of Natural Resources, 1999).

Preliminary results indicate that contaminant levels in fish and plants are some of the lowest ever detected by the Environmental Protection Agency. Several groups of chemicals (dioxins/furans, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons) were rarely detected. For almost every contaminant tested by the Environmental Protection Agency, concentrations were either completely nondetectable or were below levels of concern. Chemical concentrations for the following species were below levels of potential concern: fish (chum and sockeye salmon, cod, flounder, and halibut); invertebrates (mussel, butter clam, large clam, blue mussel, steamer clam); and plants (goose tongue, kelp, seaweed) (Environmental Protection Agency, 1998; State of Alaska, Dept. of Natural Resources, 1999).

Laboratory results showed three contaminants in several food items at concentrations that might pose a health risk to people who eat them. Polychlorinated biphenyls and traces of mercury were found in sea bass, but "[t]he concentrations of polychlorinated biphenyl's and methyl mercury are very low relative to what's been found in other studies elsewhere, and are at or below typical background levels" (Environmental Protection Agency, 1998). Cadmium detected in snails, chitons, and octopus is estimated to be attributable to natural glacial deposits. The Environmental Protection Agency is determining if the cadmium concentrations reflect background concentrations or are elevated due to human activity. These contaminants may pose a slight health risk to humans depending on how much is eaten, how often it is consumed, and how the food is prepared (Environmental Protection Agency, 1998; State of Alaska, Dept. of Natural Resources, 1999).

Some pesticides values were found to be off by a factor of 1,000 due to labeling errors, and some experts view the insufficient number of samples taken as grounds for questioning the report's overall statistical validity. Native communities wanted health alerts to be provided but the report asks readers to calculate health risks. Nevertheless, the draft report concludes that:

> based on the comparative results, Cook Inlet harvested sea foods are nutritionally sound and contaminant concentrations generally appear to be lower than or within the range of other sea foods and commercial foods. Concentrations of total polycyclic aromatic hydrocarbons and dioxin-like polychlorinated biphenyls, however, appear to be higher than comparison data (Environmental Protection Agency, 2001).

A 2001 study conducted by the National Oceanic and Atmospheric Administration and the National Institute of Standards and Technology looking for polychlorinated biphenyls in Cook Inlet beluga whales concluded that Cook Inlet belugas had much lower concentrations of polychlorinated biphenyls and chlorinated pesticides than belugas sampled in the Beaufort and Eastern Chukchi seas. Lower levels of heavy metals (cadmium, mercury, selenium, vanadium, and silver) were found in the livers of the Cook Inlet stock while levels of copper were higher. Researchers concluded that "the effects of polychlorinated biphenyls and chlorinated pesticides on animal health may be of less significance for the Cook Inlet animals than for other beluga whale stocks" (Becker et al., 2001).

In 1998, the Cook Inlet Regional Citizens' Advisory Council, at a public meeting in Kenai, Alaska, presented a synthesis and evaluation of monitoring data from their 1993-1997 environmental monitoring program. The program, conducted by Littoral Ecological & Environmental Services concluded that: (1) Sediments show extremely low levels of polycyclic aromatic hydrocarbons. The sources of these hydrocarbons are varied and mixed and cannot be attributed to Cook Inlet oil and gas development operations. There is no evidence of *Exxon Valdez* oil or Alaska North Slope oil in any of the subtidal sediments sampled, including sediments of Shelikof Strait. (2) Subtidal organisms have not accumulated or been exposed to high levels of hydrocarbons from Cook Inlet oil and gas activities. Minimal exposure to petroleum products by intertidal organisms has occurred in some instances. Mixtures of diesel and very low level combustion-derived hydrocarbons were noted in Tuxedni Bay, and fresh oil seep signals were possibly observed in Chinitna Bay. (3) Riverborne terrestrial sources of particulate coal may contribute significant levels of polycyclic aromatic hydrocarbons to the sediments throughout the region. Total napthalenes ratios tend to increase with sand-sized particles, suggesting a particulate coal-derived source for much of the polycyclic aromatic hydrocarbons observed in the sediments. Very few of the low-level polycyclic aromatic hydrocarbon signatures for either sediments or tissues could be directly tied to specific sources, and the samples suggest undocumented or multiple sources. (4) Tests using blue mussels for detecting polycyclic aromatic hydrocarbons in the water column near produced water outfall pipes did not indicate a presence of polycyclic aromatic hydrocarbons; however, high suspended-sediment loads and other factors may have diminished the test's accuracy. Despite technical difficulties, semipermeable membrane devices did show evidence of a produced-water polycyclic aromatic hydrocarbon signal in the Trading Bay area and a possible weathered diesel signal in Kachemak Bay. Methods and procedures for determining water-column hydrocarbon levels need further development (Littoral Ecological & Environmental Services, 1998).

Overall results of the Cook Inlet Regional Citizens' Advisory Council monitoring program concur with other pollution studies of Cook Inlet: contaminant levels: regardless of their source pollutants in sediments and tissues are at background levels or are undetectable, and do not pose a threat to Cook Inlet biota (State of Alaska, Dept. of Natural Resources, 1999).

Other initiatives researching contaminants in subsistence foods include a 1999 report by the Alaska Native Health Board: *Alaska Pollution Issues*. This report surveys Arctic contaminant issues, discusses the sources, pathways and distribution of these contaminants in Alaska, and summarizes what is known about their risk to subsistence-foods consumption in Alaska. For radionuclides, it concludes that the most significant source of exposure to human populations in the Arctic is from the consumption of caribou or reindeer who bioaccumulate them from eating lichens. The highest exposure levels are in eastern Canada and the lowest levels are in people who subsist on marine diets. For persistent organic pollutants, the report says that information for Alaska is sketchy. It does state that polychlorinated biphenyl and DDT levels have been measured in sea otters and blue mussels in the Aleutian Islands. Generally, the levels in Alaska are lower than in more temperate areas. The levels in Aleutian blue mussels were the highest in Alaska but were the same as levels measured off the California coast. High levels of persistent organic pollutants have been measured in some Aleutian sea otters. For heavy metals it concludes that mercury pollution is increasing in northern regions but there are significant data gaps in Alaska and what the trend is in the state is unknown. Of four studies conducted to measure human exposure in Alaska, none detected adverse health effects in Alaska Native populations from methyl mercury. Cadmium from naturally occurring sources has been found in marine mammals and may prove to be a health concern, but there is no evidence of adverse health effects in Alaska Natives from cadmium exposure through subsistence food consumption. However, State researchers believe additional research is needed to determine what safe levels of cadmium are in subsistence foods. For polychlorinated biphenyls, dioxins, and furans, studies show Alaska sea mammals having higher concentrations than any other animal tissues sampled. Sampling of fish show very low PHDH levels. In the Environmental Protection Agency's Cook Inlet study mentioned above many of the fish had no detectable polychlorinated biphenyls. The average polychlorinated biphenyl levels for Cook Inlet fish was measures at 5 parts per billion as compared to an average Great Lakes fish at 1,700 parts per billion. The Health Board report concludes that the "benefits of a traditional food diet far outweigh the relative risks posed by the consumption of small amounts of contaminants in traditional foods" (Alaska Native Health Board, 1999).

A 1998 report entitled *Use of Traditional Foods in a Healthy Diet in Alaska: Risks in Perspective* by the Alaska Department of Health and Social Services, Division of Public Health, Section of Epidemiology essentially came to the same conclusion as the Native Health Board report. It did suggest that Alaska has a critical need to examine human biomarkers of polychlorinated biphenyl exposure and that more studies on polychlorinated biphenyl concentrations in the blood serum of Alaska Natives is needed. Such information would be the most relevant in determining polychlorinated biphenyl exposure through the subsistence food chain. A comprehensive statewide screening study was advocated (Egeland, Feyk, and Middaugh, 1998).

The Alaska Native Health Board put out the *Alaska Pollution Issues Update* report in 2001. The report was the first attempt in Alaska to combine contaminant levels in subsistence foods, actual subsistence food consumption levels by Alaska Natives, and the Food and Drug Administration and the Environmental Protection Agency action levels to come up with health advisories. It concluded that

> …a small number of traditional foods contain contaminants with concentrations that are over the Food and Drug Administration action level, but most have levels below the action level. With the wide margin built in for establishing the Food and Drug Administration action level, the results should be reassuring to consumers of traditional foods. To determine definitively if these low levels are harmful only ongoing research that measures contaminant levels in Native populations will provide the answer.

Again the message was that the benefits of a traditional food diet outweigh the known risks from contaminants. In Alaska, there is not enough conclusive research at this point about health effects associated with traditional foods to issue food advisories or warnings (Alaska Native Health Board, 2002).

Various State and Federal agencies and agency partnerships are seeking to close some of the larger data gaps involving contaminants in subsistence foods. The State of Alaska, Department of Environmental Conservation with funding from the Environmental Protection Agency has begun a statewide fish monitoring project to sample Alaska fish species for environmental pollutants (Gay, 2002). The Agency for Toxic Substances and Disease Registry has partnered with the Alaska Native Health Board to conduct an Alaska Traditional Diet Project that will (1) identify traditional and "market" foods consumed in the diets of Alaska residents; (2) determine potential health risks and nutritional benefits of traditional diets; and (3) develop a shared process (incorporating Native knowledge and science) to ensure appropriate communication, education, and training within affected and concerned communities (www.atsdr.cdc.gov/). One important ongoing project is the Traditional Knowledge and Radionuclides Project being conducted by the Alaska Native Science Commission and the University of Alaska Anchorage Institute of Social and Economic Research with funding coming from the Environmental Protection Agency. The goals of the project are to allay fears of subsistence users about food contaminants, to direct Western researchers to issues that are a priority with subsistence-food users, and to get information to Native tribes so they can make their own decisions about subsistence food safety. The project has developed a database that blends Western and traditional Native knowledge about subsistence foods and contaminants and is being created so as to be easily accessible to the Native tribal user.

A massive collaboration of the Governor's Office and State, Federal, local, fisheries, and tribal entities has submitted a $30 million dollar proposal to the U.S. Senate to fund an Alaska Wild and Traditional Food Safety Program. The program hopes to accomplish the following:

1. Develop and coordinate a research, monitoring, and assessment program to measure contaminant levels and changes in those levels in Alaska's wild food resources that are used for subsistence-, recreational-, and commercial-food products.
2. Develop a fish-monitoring program to provide accurate information to Alaskans on contaminant levels found in commercial- and subsistence-fish resources.
3. Determine nutritional quality and evaluate comparative risks and benefits of wild and traditional foods to help Alaskans make informed dietary decisions.
4. Develop an Alaska and Arctic research and risk-communication clearinghouse that includes a comprehensive database on contaminants founds in wild and traditional foods, trend data on those contaminants, and a risk-communication program.

5. Develop risk management and abatement strategies, including identification of Alaskan sources of those contaminants and strategies to reduce them.
6. Pursue regional monitoring projects similar to the Canadian Northern Contaminants Program and technical assistance from our international neighbors through the Arctic Council.
7. Build partnerships and pursue funding from Congress; Federal Agencies such as the Environmental Protection Agency and Fish and Wildlife Service; and universities and foundations for an adequate research and monitoring program (www.gov.state.ak.us/oceans/contaminants.html).

The ongoing Alaska Marine Mammal Tissue Archival Project, which is funded by the MMS, supports a field sampling and long-term storage of frozen tissues archive, which has provided a wealth of information on contaminants. A newly funded MMS study called The Alaska Marine Mammal Health and Contaminants Database will make this tissue-archival information available to management agencies and subsistence villages that, by necessity, need to make their own informed and timely decisions about the safety of the environment and the subsistence foods they eat.

The concern over contaminants in subsistence foods has become a Statewide mandate. Ongoing research and these newer developing initiatives will continue to close the data gaps and begin to provide the information needed to address concerns about Native Alaskan human health concerns.

IV.B.1.p(6) Regional Traditional Knowledge on Contaminants

This section lists comments about contaminants from residents of communities.

Julie Knagin, from Kodiak stated:

> In Kodiak and all over, the cancer rate seems to have grown so fast. There are so many people dying from cancer. Almost to the point where I think you feel concerned. What is causing so much all of a sudden? There are so many factors such as Chernobyl, the oil spill (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

In Port Graham, Lydia Robards commented:

> This is why I mentioned about the black bears losing their hairs. They could be doing this because they are contaminated. We are having recycling problem and now we are really watching it….When they were putting logs in the water we didn't like it. The Log Transfer Facility was built in Port Graham and we told Werner not to put the logs in the water because of contaminants…. Lillian Elvsaas mentioned fear of cancer, colon cancer, heart disease, diets heavy in oil and cholesterol—health wise we need to go back to the nutrient balance. Right after the oil spill lots of elders in our area were afraid to eat fish…. When the water system came in with chlorine in it—that's when cancer started showing up. They first came out with that in the late 80's. Then diabetes started showing up. There are different kinds of cancers too. Female cancer. All sorts of kinds (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

Violet Yeaton, representing the Port Graham Traditional Council while appearing in Johannesburg, South Africa, in December 2000 for discussions on the ratification of the Persistent Organic Pollutants Treaty, presented this statement about contaminants in Cook Inlet:

> Our village, as many rural villages in Alaska is heavily dependent on our traditional way of life, which is deeply ingrained in our culture and very existence. Our lives and culture literally depend on the health of our traditional resources.
>
> Wild food contamination is an emerging concern in rural Alaska, especially for Alaska Natives who consume large amounts of wild food annually. Nowhere in the United States is wild food consumption greater that in Alaska's rural communities. The tribal villages of the Chugach Region are no exception. In 1995 and 1996, the Native villages of Port Graham and Nanwalek from the Chugach Region joined forces in requesting that out traditional foods be tested for contaminants. What resulted was the EPA study on contaminants of our traditional resources in the lower Cook Inlet in 1997 and 1998.

> This study found evidence of significant levels of PCB's, pesticides, and other byproducts in many important traditional species utilized by our tribal residents. The concern here is that when we eat our traditional foods, we do not eat just one chemical, we eat the whole fish with all the chemical contaminants. Eighty percent of our people's diet is made up of our traditional foods. On an average our people eat between 12 to 15 fish meals per week.
>
> None of the contaminant work done so far has been easy; in fact, it's been far from it. We realize that there are some very large and complex global pollution sources as well as some natural sources, but any sources that we can identify from Cook Inlet or nearby Alaskan areas, we hope to work towards a major clean up that may take many years but will be worth whatever effort can be generated. Out tribal peoples are trying to take responsibility for cleaning up our back yards, but this effort seems meaning less if we are being impacted globally by these contaminants.
>
> We really appreciate your efforts in this important and ongoing battle to eliminate persistent organic pollutants, including byproducts such as dioxins at the international level. We want nothing more than to restore our traditional foods top the truly pristine state they once were for our ancestors before us and for the seven generations to come. (http://archive.greenpeace.org/~toxics/html/content/popinc_testimony.html)

Lillian Elvsaas from Seldovia had these statements about contaminants:

> Is EPA doing anything for long term changing assessing? In my area they gather mussels, clams, seaweed and patroskis. I don't know why they never took seal but they never took a seal. We are in the process of asking if there can be anything done with the seal. They didn't find any contaminants. The fallout from the glaciers had some contaminants in this but not much. There were also some problems…. On the topic of "fewer clams" you can also add that the disease and contaminants might have this problem, plus the oil spill…. You know the logging site? There is a logging site in Jakaloff [Bay]. They took the logs and they dumped the logs in the bay. There are contaminants from the heavy equipment, and I think the logs are the cause of the loss of clams in the bay. I always ask around if there was any damage that was caused….Research done before the oil spill was by observation—looking at the quantity of what was there before. NOAA has books from the sixties. But there are no studies of contamination in the wild resources. They are using more potent chemicals to wipe off boats. (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

Joel Blatchford from Kasilof stated:

> When I was growing up, I was paying attention to [my father Percy] even though sometimes it seemed like I wasn't. I was born in Elmendorf. I went off on my own for a while but I always paid attention to the food because my dad showed me what to pay attention to. I've worked from Shemya to Barrow. A lot of people don't listen to us. It is only the Natives that seem to want to listen. We as people know that things are changing. I pay close attention to this Inlet (Cook Inlet) and that is why I stopped eating food from this Inlet. I just don't want to see people get sick and they shouldn't eat it. If you watch the changes in the Inlet like I do, then you wouldn't eat the food from it. I'd rather take a chance eating out of the supermarket than eat food from the Inlet… I have turned away from traditional foods. Scientific journals show concerns. Oil cartels say that the Inlet (Cook Inlet) is a flushing system. Government shows that the Inlet is a holding tank, not a flushing system. Radon comes from drilling oil. We can't prove it because we don't have scientific knowledge like you do. I paid attention (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

Percy Blatchford from Anchorage discussed contaminants in beluga whales:

> In 1946 I was alone and killed a beluga for the first time. When the tide went out, I checked the whale and saw it had a spot. I reported it to Fish and Wildlife and they wouldn't do anything about it. It took a Geiger counter—the doctors started believing me afterwards. I said I've been to a place no one had been before. They tested me, but they couldn't find anything…. They told me I didn't know what I was talking about. My son was three years old and my girl was 5 years old. We went over there to kill the whale and I told my son, "This has radiation in it." I cut it open and the agency wouldn't believe me for a long time until we sent a sample outside to a doctor—about

> 50 pounds. The doctors outside sent me back the report that said there was radioactivity in this whale. I should maybe tell them that. Anyway, that was the first time they'd seen radioactivity in the whale—I was the only one that reported the radiation across there. You can look at a person and tell he has a sickness by how he breathes and how he looks. I told them, but they didn't believe me, but the spot on the beluga went straight into the inside—you could tell by looking at it. If there are spots on stuff you shouldn't eat it. Throw it away or get it tested (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000[UAA, ISER, 2002]).

Gregg Tagarook, from Wainwright, also tells of beluga contamination:

> I started hunting in Cook Inlet in 1946 for belugas. I reported to Fish and Wildlife that the belugas I saw had signs of radiation exposure. We cut up belugas and took them to the doctors to have them tested for radiation. They wouldn't test them. I hired a private doctor from Wisconsin. He did test the samples I sent, and said that I was right (Alaska Traditional Knowledge and Native Foods Database, Northwest Arctic Regional Meeting, September 1998[UAA, ISER, 2002]).

Gary Harrison from Chickaloon, had this to say about sewage discharges into in Cook Inlet:

> The sewage from Anchorage is flushed into the Inlet. They treat it with chlorine and pump it into the Inlet. They say it is clean. We need to look at what has happened and stop it in the future. They still aren't getting to the problems with pollutants (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

In Chignik Bay, one hunter used to see sea otters all over. But now, he said, "they don't come into the Bay. Why do they let them dump things into the bay? They should make the canneries pump the waste products outside of Anchorage Bay where there are more currents to wash it away. Here it just sits. I don't blame the birds and animals to not want to come around anymore" (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

Hunters from Chignik Lagoon have heard that seal livers are high in lead and, over the last few years, they have noticed salmon with red splotches. They said they were told it is caused by a parasite, but they had never seen this in salmon prior to 3 years ago. They have noticed some salmon puffed out with water and others with two backbones while cleaning subsistence salmon catch (Whiskers! Database, State of Alaska, Dept. of Fish and Game, 1999).

IV.B.1.p(7) In-Place Mitigation and Ongoing Mitigation Initiatives

Mitigating measures that would have the most effect on Environmental Justice include Stipulation No. 1 - Protection of Fisheries, which directs the operators to avoid unreasonable conflicts to the fishing community, including the subsistence fishery. It also provides for a review of the exploration plan and the development and production plan by subsistence communities. Stipulation No. 3 - Orientation Program, is designed to inform oil-patch employees about specific environmental and sociocultural concerns that relate to the proposed sale area. Any orientation program would provide information to workers to increase their sensitivity toward local community values, customs, and lifeways to avoid conflicts with traditional culture and subsistence pursuits.

The ITL No. 3 - Sensitive Areas to be Considered in the Oil-Spill-Response Plans directs operators to pay special attention to specifically identified areas of biological concern when developing oil-spill-response plans. The ITL clause instructs operators to identify important cultural sites and areas critical to subsistence resources and harvests in oil-spill-response plans and provided specific protective measures for these areas, specifically as regards the use of dispersants in these special areas. The ITL No. 5 - Information on Oil-Spill-Response Preparedness makes sure that the oil-spill-response plan addresses, among other things, the location of appropriate oil-spill equipment and the ability of the operator to protect communities and important resources in case of a spill. This ITL clause would provide special consideration in oil-spill-response plans for the protection of smaller, subsistence-based communities and their subsistence resources. The ITL No. 6 - Drilling Fluids and Cuttings Discharge During Post-Lease Activities advises the lessee that the Environmental Protection Agency prohibits the discharge of drilling fluids and cuttings into marine waters unless authorized by an approved National Pollution Discharge Elimination System permit. It advises the lessee to explore other methods for disposing drilling discharges.

Overall water quality and the elimination of discharges into marine waters is a growing concern with local stakeholders, especially among regional subsistence hunters.

The MMS supports initiatives to train village oil-spill-response teams as a way of guaranteeing local participation in spill-response and cleanup; this effort provides a form of control and allows local Native communities to use their traditional knowledge about weather and currents in the response process. Within the constraints of Federal, State, and local law, operators and Cook Inlet Spill Prevention and Response, Inc. would be encouraged, through a voluntary program, to hire and train Native residents of the Cook Inlet/Shelikof Strait region in oil-spill response and cleanup.

The MMS also is working with the oil industry to develop a comprehensive plan for dealing with subsistence claims, should an oil spill occur. The plan would include what constitutes proof of previous subsistence activities, what information is needed to support a claim, and how subsistence losses would be calculated for restitution. The object would be to develop a subsistence claim process manual that sets out the protocol for a subsistence hunter to follow in filing a claim. The U.S. Coast Guard is responsible for administering damage claims from oil spills, including impacts to subsistence resources and users. The U.S. Coast Guard is considering new rulemaking specifically directed at subsistence compensation. The MMS requires all operators to provide financial responsibility through bonds as required by the Oil Pollution Act of 1990.

Other suggested mitigation initiatives for impacts on subsistence species from oil spills include potential staging of equipment at critical locations to support any necessary oil-spill-cleanup operations. This initiative would address response-readiness concerns of subsistence users. In addition, encouraging the staging of boom material and other pertinent response equipment at local subsistence communities would provide protection to critical resource areas and shoreline. These measures could be included in the oil-spill-contingency plan or in the final Condition of Permit approval letter for a production project issued by the Regional Supervisor for Field Operations. Collectively, these stipulations and other proposed mitigation would aid substantively in mitigating against contamination to onshore habitats and subsistence resources.

In its November 2001 meeting, the OCS Policy Committee discussed the possibility of the Department of the Interior determining a way to provide funds to tribal and local governments for training and travel needs to facilitate their participation in Department of the Interior planning and decision-making processes. Without funding, these executive orders are perceived by the Native community simply as new “unfunded mandates.” Funding of this nature would ameliorate some of the stress caused in small Native villages from the burden of participation in the agency public process.

More specifically, and based on Native stakeholder concern, the MMS has addressed cumulative impacts by redesigning its approach to oil-spill risk to make its methodology better suited to the Cook Inlet region. Another initiative pursued by the MMS to improve its analysis of cumulative impacts has been through a cooperative agreement with the Alaska Department of Fish and Game, Subsistence Division, whereby the MMS provides funding for the collection and maintenance of the State-maintained Community Profile Database, which is the only long-term archive of subsistence data in the State.

Ongoing and proposed MMS studies that address environmental justice concerns will provide valuable data for the assessment of cumulative impacts of oil and gas activities. The MMS Study 2001-032 *Sociocultural Consequences of Alaska OCS Activities: Data Analysis and Integration*, a cooperative agreement with State of Alaska, Department of Fish and Game, Subsistence Division, analyzes and integrates subsistence, socioeconomic, and sociocultural time-series data from previous MMS-sponsored projects to assess the occurrence and implications of sociocultural change from OCS activities. The *Exxon Valdez Oil Spill, Cleanup, and Litigation: A Community-Based Collection of Social-Impacts Information and Analysis, 1989-2001* study provides an analytical tool from the synthesis of the *Exxon Valdez* oil spill literature that assists MMS analysts in preparing NEPA documents, designing mitigating measures. This study facilitates the review of oil-spill-contingency plans, and paves the way for a dialogue with coastal communities regarding the MMS offshore program.

The ongoing Alaska Marine Mammal Tissue Archival Project field sampling and long-term storage of frozen tissues archive has provided a wealth of information on contaminants. A proposed study called *The Alaska Marine Mammal Health and Contaminants Database* will make this tissue-archival information available to management agencies and subsistence communities that, by necessity, need to make timely decisions about the safety of the environment and subsistence foods.

While these efforts in themselves would not resolve the larger problems of ongoing cultural challenge to regional Native traditions from increasing development activities and from the powerful influences of modernity, such as cable television, the Internet, and an increasing dependence on a wage-based economy, they provide processes for information sharing and opportunities for mutual decisionmaking and remediation of cumulative social and subsistence impacts.

The MMS studies that address stakeholder concerns about oil and oil-spill preparedness include studies on the *Persistence of Crude Oil Spills on Open Water, Drifter Testing and Evaluation for Oil-Spill Trajectory Modeling in Cook Inlet and Shelikof Strait*, and the *Alaska Marine Mammal Health and Contaminants Study*. Recently completed and ongoing studies under the MMS/University of Alaska Fairbanks, Coastal Marine Institute have investigated biochemical fate of oil, including ongoing research titled *Kinetics and Mechanisms of Slow PAH Desorption from lower Cook Inlet and Beaufort Sea Sediments*.

Over the years, traditional knowledge frequently has been used in helping to design studies and to ensure appropriate objectives. The MMS has initiated or planned studies that devote increased resources to integrating traditional knowledge into studies planning and reporting. The MMS has incorporated traditional knowledge in its EIS's and mitigating measures and has used traditional knowledge in EIS's for Sales 144, 170, and Beaufort Sea (USDOI, MMS, Alaska OCS Region, 1996, 1998, 2003); the Northeast NPR-A Integrated Activity Plan/EIS (USDOI, BLM and MMS, 1998); and the Liberty Development Plan draft EIS (USDOI, MMS, Alaska OCS Region, 2002). The September 2000 MMS study entitled *Mapping Cook Inlet Rip Tides Using Local Knowledge and Remote Sensing* was a particular MMS initiative to tap the local and traditional knowledge information base to expand the overall EIS analysis process. Traditional knowledge will also be incorporated into this document.

The MMS's Technology Assessment research is aimed at promoting safety of operations and prevention of oil spills and air pollution. These studies investigate and assess various safety-related technologies and perform applied research, if necessary. Study results support the technology basis for MMS's permitting of drilling and production operations, safety and pollution inspections, in addition to various other decisions. Since 1990, the MMS has funded more than $1 million worth of studies with Alaska institutions and companies addressing technology assessment issues. Some of the current projects addressing Alaska OCS issues include *Risk Assessment for Ice Damage to Subsea Pipelines – C-CORE* to review current practices for assessing risk of ice damage to marine pipelines, to establish a natural modeling framework for risk assessment, and to prioritize areas of data collection and model development to reduce risk and uncertainties in the design of arctic pipelines.

The MMS, along with the State of Alaska, industry, and Regional Citizen Advisory Councils, was a major sponsor of the International Oil and Ice Workshop held in Anchorage in April 2000. The workshop provided an international forum for presentation and discussion of key environmental, operational, and logistical topics associated with oil exploration and development in ice-prone environments. The MMS, the State of Alaska, the U.S. Coast Guard, and Great Britain have funded a joint industry project to determine the fate and effects of chemically dispersed oil at sea. The project will examine the biodegradation of natural and chemically dispersed oil as a function of time. Conclusions will be used to provide information on the use/nonuse of dispersants in offshore and nearshore environments. The State of Alaska and MMS cofunded a project to determine the optimal times required to decant (remove water) from temporary storage devices. This will minimize the oil content of discharged waters produced by oil-skimming operations. This study will directly benefit spill-response operations by ensuring that the full potential of available skimming and storage systems is used. Testing for this project was conducted at the MMS Ohmsett test facility in November 1998. Additional decant tests were scheduled at Ohmsett in Spring 2000. This project is complete and the final report, *Testing at Ohmsett to Determine Optimum Times to Decant to Temporary Storage Devices*, is available. Alaska Clean Seas completed an evaluation of burning efficiencies of Alaskan crude oil in a wave environment. This effort was funded through the MMS, the State of Alaska, and the oil and gas industry. The final report was issued in June 1998. Alaska Clean Sea and the MMS participated in a joint industry project—Mechanical Oil Recovery in Ice Infested Waters (MORICE)—which has demonstrated potential to improve mechanical recovery in ice-covered waters. Currently, the State of Alaska does not recognize nonmechanical response techniques (in situ burning and dispersants), and this project is intended to provide additional options for the cleanup of oil in broken ice.

Other cooperative efforts that the MMS is pursuing with the State of Alaska include a Memorandum of Understanding on Coastal Zone Management between the State of Alaska, Division of Governmental Coordination, and the U.S. Department of the Interior, MMS (Alaska OCS Region) to establish procedures to facilitate coordination with respect to the Coastal Zone Management Act Section 307 consistency determinations prior to an MMS lease sale. A separate Memorandum of Understanding sets out the coordination procedures for seismic activities and for processing postlease-sale plans and permits. The MMS and the State plan to update these Memoranda of Understanding, partly as a result of the new National Oceanic and Atmospheric Administration regulations and changes in State Coastal Zone Management Plan implementing regulations. A 1994 Letter of Agreement with the Department of Environmental Conservation was developed to facilitate coordination of MMS Oil Pollution Act responsibilities for response plans on State facilities in Cook Inlet. The MMS wants to update the Letter of Agreement to reflect final Oil Pollution Act regulations and to clarify and resolve discrepancies between MMS Oil Pollution Act and State oil-spill standards, and to expand the Letter of Authorization to include North Slope facilities. There are 16 permanent production facilities on State submerged lands subject to MMS Oil Pollution Act permit authority. The MMS is an active member in the Joint Federal/State Pipeline Office, which facilitates coordination of MMS pipeline responsibilities with other Joint Pipeline Office members and provides Joint Pipeline Office members better access to MMS technical research. Another important oil-spill mitigation initiative is the geographic response strategies developed by Cook Inlet Spill Prevention and Response, Inc., that define protective measures to be implemented at many heavily used subsistence sites in Cook Inlet to prevent or minimize potential contamination from an oil spill.

IV.B.1.p(8) Mitigating Initiatives Related to Sociocultural Impacts

In evaluating potential sociocultural impacts, the MMS has produced a substantial environmental justice analysis for Alaska as it relates to the Native Alaskan subsistence way of life. Environmental Justice analyses have been written for OCS Sale 170, the Bureau of Land Management’s leasing initiatives in the National Petroleum Reserve-Alaska, The Beaufort Sea multiple-sale draft EIS, and the Liberty Project EIS.

Since 1999, all MMS public meetings have been conducted under the auspices of Environmental Justice, and presentations on the Executive Order and how MMS is addressing it have been made at scoping and government-to-government meetings. The Environmental Justice process followed for the Cook Inlet multiple-sales included: (1) initial scoping, (2) notices in local newspapers, and (3) future followup meetings that included meetings specific to Environmental Justice concerns and mitigation. From this process, the MMS received feedback on specific Environmental Justice concerns and documented these various concerns of Native and minority residents. Environmental Justice concerns were taken back to MMS management and incorporated into environmental studies’ designs and new mitigation measures. At this point in the assessment process, no new mitigating measures/stipulations are being considered; the MMS believes that Environmental Justice is enhanced by the ITL clauses. For example, inclusion of the Port Graham/English Bay Area Meriting Special Attention was added to ITL No. 3 - Sensitive Areas to be Considered in Oil-Spill-Response Plans at the suggestion of Alaskan Natives during scoping because of the importance of the subsistence resources in this area to Native villages.

Environmental Justice concerns were solicited in the Cook Inlet region from meetings with the communities of Homer on January 30, 2002, and Seldovia on January 31, 2002; from Government-to-Government meetings with the Seldovia Indian Reorganization Act Council on February 1, 2002; in Nanwalek on February 8, 2002, in a public meeting and a meeting with the Nanwalek Indian Reorganization Act Council; in Ninilchik on February 8, 2002; and in Port Graham in a public meeting and the Port Graham Indian Reorganization Act Council on February 11, 2002. The MMS maintains a dialogue on Environmental Justice with these communities; followup meetings to address Environmental Justice issues will be held as required by the MMS or as requested by local governments.

Major concerns expressed at these meetings included:

- Potential contamination of subsistence resources from postlease and non-OCS activities (see Section IV.B.1.p - Effects on Environmental Justice; see also the cumulative-effects section at V.C.5.p, Environmental Justice).

- Need for specific plans to avoid impacts on subsistence resources (see Sections IV.B.1.1 - Effects on Subsistence-Harvest Patterns, IV.B.1.p - Effects on Environmental Justice, IV.B.3 - the Lower Cook Inlet Deferral, IV.B.4 - the Barren Islands Deferral, and II.F - Stipulation No. 1 - Protection of Fisheries).
- Deferral of the eastern portion of the Lower Kenai Peninsula to protect subsistence resources (see Sections IV.B.3 - the Lower Cook Inlet Deferral and IV.B.4 - the Barren Islands Deferral).
- Potential water-quality contamination from drilling discharges of subsistence resources and potential human health effects that might result (see Sections IV.B.1.a - Effects on Water Quality and IV.B.1.p - Effects on Environmental Justice).
- Concerns about contaminants in subsistence foods and the need to address allowable levels of contamination and consumption levels appropriate to Alaskans (see Sections IV.B.1.1 - Effects on Subsistence-Harvest Patterns and IV.B.1.p - Effects on Environmental Justice).
- Concern that an eddy off Port Graham, Nanwalek, and Seldovia may concentrate contaminants from other areas in Cook Inlet (see Sections IV.B.1 - Effects on Water Quality and IV.B.1.p - Effects on Environmental Justice).
- Need for a followup subsistence contaminant study to the 1998 Environmental Protection Agency study (see Section IV.B.1.p - Effects on Environmental Justice).
- Need for tribes to be informed of contaminant studies' results before they are released to the public (see Sections IV.B.1.1 - Effects on Subsistence-Harvest Patterns and IV.B.1.p - Effects on Environmental Justice; see also the cumulative effects sections for these resources at V.C.5.1 - Subsistence-Harvest Patterns and V.C.5.p - Environmental Justice).
- Consideration of past and ongoing sociocultural impacts of the *Exxon Valdez* oil spill and cumulative impacts in general (see Sections IV.B.1.1 - Effects on Subsistence-Harvest Patterns and IV.B.1.m - Effects on Sociocultural Systems; see also the cumulative effects sections for these resources at V.C.5.m - Sociocultural Systems and V.C.5.p - Environmental Justice).
- Oil-spill and oil-spill-cleanup effects of cultural resources (see Sections IV.B.1.q - Effects on Archaeological Resources and VII - Responses to Comments)
- Need for tribes to have response equipment, community response training, and assistance for oil-spill cleanup (see Sections IV.B.1.p - Effects on Environmental Justice and IV.A.5 - Spill Prevention and Response).
- Improved communication with the village of Nanwalek (see Sections III.C.7 - Environmental Justice and IV.B.1.p - Effects on Environmental Justice).
- Importance of ongoing government-to-government communication with tribes (see Sections III.C.7 - Environmental Justice and IV.B.1.p - Effects on Environmental Justice).
- Air quality impacts in lower Cook Inlet (see Section IV.B.1.b - Effects Air Quality).
- Reduction of past impacts to subsistence resources (see Sections IV.B.1.1 - Effects on Subsistence-Harvest Patterns and IV.B.1.p - Effects on Environmental Justice; see also the cumulative effects sections for these resources at V.C.5.1 - Subsistence-Harvest Patterns and V.C.5.p - Environmental Justice).
- Identification and protection of critical habitat areas for sensitive fish and endangered species (see Sections IV.B.1.e - Effects on Essential Fish Habitat and IV.B.1.f - Effects on Endangered and Threatened Species).
- Need to reduce exploration and development conflicts with driftnet and setnet gear (see Sections IV.B.1.d - Effects on Fisheries Resources, IV.B.1.o - Effects on Sportfishing and II.F - Stipulation No. 1 - Protection of Fisheries).
- Need for impact assistance to coastal communities (see Section IV.B.1.p - Effects on Environmental Justice).

Part of the MMS's sensitivity to the Athabascan and Alutiiq ways of life is to ask when it can come to villages to hold meetings. The MMS tries to accommodate village schedules. The MMS continues to take a more collaborative approach in its public involvement and has learned the value of spending more time in these local communities. The MMS has hired a community liaison who spends a large part of his time maintaining contacts with local Native communities and making sure that scoping and public meetings are scheduled so they do not conflict with local activities. The MMS also writes executive summaries for its EIS's that it believes make projects easier for the public to assess. We believe this cooperative approach can lessen the stress of our public involvement mandate, and we welcome suggestions on how to make this process better.

For half a decade, the MMS has included what the local Natives are saying in the text of its lease-sale and production EIS environmental analyses. Native traditional knowledge has been solicited from sources that include past and more recent testimony from community meetings on lease-sale hearings, in addition to other available published sources of traditional knowledge. This traditional knowledge has been included (with the speaker cited in text and in the bibliography) in the effects analyses sections of the EIS's for Sales 144 and 170, the Northeast National Petroleum Reserve-Alaska EIS, the Liberty Project EIS, and the Beaufort Sea multiple-sales EIS. In this way, traditional knowledge is considered in the planning and decisionmaking processes and in the formulation of new mitigation. Traditional knowledge used in analysis is reviewed by local and regional Native groups.

In-place stipulations that address sociocultural impacts include the Orientation Program stipulation that requires the lessee to instruct its workers on exploration, development, and production projects about the environmental, social, and cultural concerns that relate to the area and its Native communities. The program increases workers' sensitivity to, and understanding of, values, customs, and lifestyles of local Native communities and helps prevent any conflicts with subsistence activities. Industry-monitoring programs include specific issues of concern related to wildlife interaction, protection of marine mammals, best management practices to minimize the potential for spills, awareness of local sociocultural issues and concerns, and awareness of subsistence resources and activities. The overall training program will be submitted to the MMS for review and approval. Personnel will receive appropriate training on at least an annual basis.

Following a policy of community-based research, the Alaska OCS Region, Environmental Studies Section, promotes studies that directly address the standing issues and concerns of Native stakeholders. The MMS includes local and tribal governments in its studies planning process and has held meetings in all local communities to assist their participation in this effort. One important study funded by MMS was the *Exxon Valdez Oil Spill, Cleanup, and Litigation: A Community-Based Collection of Social-Impacts Information and Analysis, 1989-2001*; the study produced an analytical tool from the synthesis of the *Exxon Valdez* oil-spill literature that will assist MMS analysts in NEPA document preparation, the design of mitigation measures, facilitate the review of oil-spill-contingency plans, and pave the way for a dialogue with coastal communities regarding the MMS offshore program. Other studies that the MMS has funded to address sociocultural impacts are discussed in the general mitigation discussion.

The MMS's community liaison, Albert Barros, was instrumental in getting an Alaska-wide Department of the Interior Memorandum of Understanding with Alaskan tribes on Government-to-Government relations signed by all the Alaska Department of the Interior Agency Regional Directors. The MMS also is pursuing a Memorandum of Understanding with Nunagpet/Chugachmiut Environmental Protection Consortium to formalize its Government-to-Government consultation mandate with local tribes.

Local communities have been very vocal about finding a "compensation" source—impact assistance, revenue sharing, bonds, or mitigation payments—to address impacts from OCS activities. By law, the MMS cannot provide or require industry to provide such compensation. Federal Agencies cannot commit to impact assistance, because that is a role of Congress and not the Executive Branch. Only Congress can alter the OCS Lands Act to include provisions for local impact assistance from MMS revenues or provide the authorization for funding such revenues. Nevertheless, in response to this critical concern, Department of the Interior and MMS staff have done extensive work on developing OCS impact assistance and revenue sharing concepts and frequently have drafted legislative language on this subject in response to Congressional requests. Furthermore, the MMS OCS Policy Committee has developed a white paper on impact assistance and revenue sharing options and has shared this paper and its findings with concerned policymakers. In a one-time effort in 2001, Congress appropriated impact-assistance funds for coastal states affected by oil and gas production. Alaska received an appropriation of $12.2 million; of this, the Kenai Peninsula Borough received $208,665, the Kodiak Island Borough received $189,985, and the Lake and Peninsula Borough received $70,270. Within the first 3 miles of the Alaska OCS, 27% of all OCS leasing, rental, and royalty receipts goes to the State of Alaska. The State of Alaska has received more than $7.9 million from the National Historic Preservation Fund. Some of this money has been used for grants to local communities. Revenues from Federal offshore mineral leases sustain this fund at $150 million. The law specifies how annual appropriations of the fund support matching grants to the States and National Trust for Historic Preservation. Each State in turn must award 10% of its annual fund allocation to certified local governments as sub-grants. In addition, Alaska Native groups have received more than $2.4 million from the National Park Service Tribal Preservation Program. This program assists Native Americans in preserving their historic properties and cultural traditions and is administered by the National Park Service. The program is dedicated to working with Indian tribes, Alaska Native groups, and national organizations to preserve and protect resources and traditions that are important to Native Americans. Also, subsistence impact funds administered by the U.S. Coast Guard under the Oil Pollution Act of 1990 would be available, in the unlikely event of an oil spill, to provide for subsistence-food losses. For a discussion of Environmental Justice cumulative impacts, see Section V.C.5.p.

After the *Exxon Valdez* oil spill, the Prince William Sound Regional Citizens' Advisory Council sponsored research to learn how to mitigate the psychological and sociological impacts of a major oil spill or other technological disaster. The mitigation strategies are contained in the guidebook *Coping With Technological Disasters*. This guidebook is a virtual human impacts "contingency plan," and provides the framework for communities to be proactive in setting up a government command structure, provides coping strategies for local businesses, protocols for volunteers and community outreach and training, in addition to protocols concerning better use of the press and other media to get the information out to the affected community. Most importantly, it deals with the mental health issues of a catastrophic oil spill or other technological disaster and maps out a total community coping strategy (www.pwsrcac.org/oldsite/CWTD/CWTDmenu.html).

IV.B.1.p(9) Development Benefits

The MMS believes there would be some clear benefits derived from production projects: an ad valorem tax would accrue to the Kenai Peninsula Borough from new onshore infrastructure (landfall infrastructure and pipelines) associated with such development. Oil from these projects would help keep flow capacity up in the local peninsula pipeline network, a situation that helps the local tax base. Industry local-hire initiatives are increasing in terms of the variety of programs being offered to train and attract Native workers for long-term employment on any infrastructure construction. The MMS cannot require local hire, but the MMS and other Federal Agencies can inform the operator of the Native concerns for more local employment from nearby oil and gas activities.

IV.B.1.p(10) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

If the scenario takes place exclusively as the result of Lease Sale 199, the activities would be undertaken 2 years later (starting in 2006) but would not differ in location, duration, or magnitude. The actions would cause the same effects described for Sale 191, only 2 years later.

IV.B.1.q. Effects of Sale 191 on Archaeological Resources

This section analyzes the potential impacts of the proposed Sale 191 on archaeological resources. The known and potential archaeological resources of the project area are described in Section III.C.8. Archaeological resources are the material remains of past human activities and include both historic (generally after European contact) and prehistoric sites. Archaeological resources can occur both onshore and offshore. Most offshore historic resources are shipwrecks.

IV.B.1.q(1) Conclusion

Impacts from routine activities can be avoided by either mitigating the impacts prior to disturbance or by moving or modifying the proposed activity to avoid the identified resource. Therefore, the impact of routine activities associated with the Proposed Action on archaeological resources probably would not be significant. In the unlikely event of a large oil spill, the numbers of archaeological resources within the spill area that would suffer damage probably would be similar to those documented for the Exxon Valdez oil spill (i.e., 2.3-2.4%). Plans and procedures that have been developed for the Cook Inlet area to protect archaeological resources in the event of an accidental oil spill also would serve to mitigate impacts, should *a large spill occur. Considering these factors, the estimated impact to archaeological resources from a large oil spill as a result of the Proposal is not significant. Effects from a large natural gas release would not be significant.*

IV.B.1.q(2) Effects from Exploration

Routine operations associated with exploration that may have an effect on archaeological resources include any activities that cause physical disturbance to the seafloor or coastal areas, such as the placement of drilling rigs and anchors.

Regulations at 30 CFR 250.194 allow the Regional Director to require that an archaeological report based on geophysical data be prepared, if there are indications that a significant archaeological resource may exist within a lease area. For historic resources, this decision is based on whether a historic shipwreck is reported to exist within or adjacent to a lease area (see Section III.C.8.b(2)). For prehistoric resources, an analysis is completed that considers the relative sea-level history, the depth of burial of the late Wisconsin land surface, the type and thickness of sediments burying the old land surface, and the severity of geologic processes that may have disturbed or destroyed archaeological sites within the sale area (see Section III.C.8.b(1)). Based on these analyses, lease areas that have potential for archaeological resources are required to have an archaeological survey prior to initiating exploration activities (see Map 1 and Tables III.C-15 and III.C-16 for a list of these lease areas). If the survey finds evidence of a possible archaeological resource within the lease area, the lessee must either move the proposed activity to avoid the possible resource or conduct further investigations to determine if an archaeological resource actually exists at the location. If an archaeological resource is present at the location of proposed activity and cannot be avoided, the MMS procedures require consultation with the State Historic Preservation Office to develop mitigating measures prior to any exploration activities. It is assumed for this analysis that the level of protection provided by the regulation for offshore archaeological resources is in place.

Federal, State, and local laws and ordinances, including the National Historic Preservation Act, the Archaeological Resources Protection Act, and the Alaska Historic Preservation Act, protect known sites and also areas where presently unidentified archaeological resources may occur. Existing regulations require archaeological surveys to be conducted prior to permitting any activity that might disturb a significant archaeological site. Therefore, most archaeological resources will be located, evaluated, and mitigated prior to any onshore construction. New data related to the human history and prehistory of Alaska likely will be produced from compliance-related archaeological projects associated with the Proposal.

If, despite required archaeological analyses and surveys, a significant archaeological resource were disturbed by a routine activity, the magnitude of the impact would depend on the significance and uniqueness of the information lost. However, due to existing laws and regulations that serve to identify significant archaeological resources prior to disturbance, it is unlikely that such an impact would occur as a result of exploratory activities associated with the Proposed Action.

IV.B.1.q(3) Effects of Development and Production

IV.B.1.q(3)(a) Effects from Routine Operations

Routine activities associated with development activities that may have an effect on archaeological resources include drilling wells, platform installation, anchor placement, pipeline installation, and onshore facility and pipeline construction projects that involve ground disturbance and possible small onshore oil pipeline leaks. A release of natural gas would have no significant effects on archaeological resources. If a significant archaeological resource were disturbed or destroyed by a routine activity, the magnitude of the impact would depend on the significance and uniqueness of the information lost. However, due to existing laws and regulations that serve to identify, evaluate, and mitigate significant archaeological resources prior to disturbance (described for exploration activities above), it is unlikely that such an impact would occur as a result of development activities associated with the Proposed Action.

IV.B.1.q(3)(b) Effects from Large Oil Spills

Accidental oil spills could impact beached shipwrecks, or shipwrecks in shallow waters, and coastal historic and prehistoric archeological sites. Oil spills and their subsequent cleanup could impact the archaeological resources of the Cook Inlet area directly or indirectly, or both. Archaeological resource protection during an oil spill requires specific knowledge of the resource's location, condition, nature, and extent prior to impact; however, large portions of the Cook Inlet coastline have not been systematically surveyed for archaeological sites. The sites that are known include National Register sites within the western Kodiak Island area, the southern Kenai Peninsula, and the Alaska Peninsula.

Gross crude oil contamination of shorelines is a potential direct impact that might affect archaeological site recognition. Heavy oiling conditions (Whitney, 1994) could conceal intertidal sites that may not be recognized until they are inadvertently damaged during cleanup. Crude oil also could contaminate organic material used in Carbon-14 dating and, although there are methods for cleaning contaminated Carbon-14 samples, greater expense is incurred (Dekin, 1993). However, many other anthropogenic sources of hydrocarbons and other possible contaminants also exist, and caution should always be taken when analyzing radiocarbon samples from coastal Alaska (see Reger, McMahan, and Holmes, 1992.

The major source of potential impacts from oil spills is the indirect effects that result from unmonitored shoreline cleanup activities. Unmonitored booming, cleanup activities involving vehicle and foot traffic, mechanized cleanup involving heavy equipment, and high-pressure washing on or near archaeological sites pose risks to the resource. Unauthorized collecting of artifacts by cleanup crew members also is a concern, albeit one that can be mitigated with effective training and supervision. As Bittner (1993) described in her summary of the *Exxon Valdez* oil spill: "Damage assessment revealed no contamination of the sites by oil, but considerable damage resulted from vandalism associated with cleanup activities and lesser amounts were caused by the cleanup process itself."

The numbers of archaeological resources that may be impacted by a large oil spill in the Cook Inlet proposed Sale 191 area probably would be similar to or less than those documented from the *Exxon Valdez* oil spill. Two studies of intertidal disturbance, the *Exxon Valdez Cultural Resource Program* and a paper on archaeological protection presented at the Atlanta meeting of the American Society of Testing and Materials, are in close agreement as to the effects of the spill on shoreline and intertidal resources. In the first study by Mobley et al. (1990), there were 1,000 archaeological sites in the area affected by the *Exxon Valdez* oil spill (AHRF, 1993), and about 24 of these, or 2.4%, were damaged (Mobley et al., 1990). In the second study (Wooley and Haggarty, 1993), a total of 609 sites were identified, and of these 14, or 2.3%, were damaged. The findings of these two studies are in agreement; that less than 2.3-2.4% of the sites in the area affected by the *Exxon Valdez* oil spill suffered damage.

Subarea plans that have been developed for several areas of Alaska, including Cook Inlet, outline procedures for addressing and mitigating potential impacts to archaeological resources should an oil spill occur (Alaska Regional Response Team, 2000). Interagency and regulatory aspects of oil spill archaeological site protection have recently been clarified. A programmatic agreement (Alaska Regional Response Team, 1997) specifies the Federal On-Scene Coordinator's role in protecting archaeological resources, the type of expertise needed for site protection, and the appropriate process for identifying and protecting archaeological sites during an emergency response. Under the agreement, the Federal On-Scene Coordinator's Historic Properties Specialist coordinates and directs the site identification and protection program, with consultation and cooperation of the Unified Command and other affected and interested parties.

This analysis assumes the occurrence of one large spill (greater than 1,000 barrels); however, the chance of one or more spills of 1,000 barrels or larger is 19%. If a large spill did occur, the numbers of archaeological resources within the spill area that would suffer damage probably would be similar to those documented for the *Exxon Valdez* oil spill (i.e., 2.3-2.4%). The magnitude of the impact would depend on the significance and uniqueness of the archaeological information lost. If significant archaeological information were lost the impact would be significant; however, plans and procedures that have been developed for the Cook Inlet area to protect archaeological resources in the event of an accidental oil spill would serve to mitigate impacts. Considering all of these factors, the expected impact to archaeological resources from a large oil spill as a result of the Proposal is not significant.

IV.B.1.q(3)(c) *Effects from Large Natural Gas Release*

Effects to archaeological resources result primarily from physical disturbance of archaeological resource sites. An accidental release of natural gas from a gas-well blowout or pipeline rupture should not cause disturbance to the sites and is not expected to have measurable effects on Cook Inlet archaeology resources.

IV.B.1.q(4) Difference in Effects from Sale 191 Alternative 1 Activities Compared to Sale 199 Alternative 1 Activities

Potential effects on archaeological resources from Sale 199 activities would not be different than potential effects from Sale 191.

IV.B.1.q(5) Effectiveness of Mitigating Measures

Federal, State, and local laws and regulations protect known sites and also areas where presently unidentified archaeological resources may occur. Existing regulations at 30 CFR 250.194 require archaeological surveys to be conducted within offshore lease areas of identified archaeological resource potential prior to permitting any activity. It is assumed that these required analyses and surveys are highly effective in locating, evaluating, and mitigating impacts to significant archaeological resources prior to any lease or construction activity. Plans and procedures that have been developed for the Cook Inlet area to protect archaeological resources in the event of an accidental oil spill also would serve to mitigate impacts, should a large oil spill occur. For mitigation of damage to onshore archaeological resources, the orientation program will inform project personnel of the location of archaeological resources that should be avoided and steps that need to occur if a previously unknown resource is detected during operations.

IV.B.1.r. Effects of Sale 191 on National and State Parks and Special Areas

This section examines the potential effects of the Proposed Action to the intrinsic qualities of the national parks, national wildlife refuges, State parks, and other special areas adjacent to the proposed sale area (see Figure IV.A-2).

IV.B.1.r(1) Conclusion

The Proposed Action is not expected to cause any effects during exploration. During development, onshore construction may cause the disruption and diminishment of recreational values of State recreational areas located along the Kenai Peninsula coast. Such effects, however, would be transient, encompassing two seasons, and could be mitigated. The principal effects from the Proposed Action would come from spilled oil. Should oil be spilled, there is a reasonable chance that either the coastlines of Katmai or Lake Clark National Park would be affected. Actual effects on the intrinsic and visual values of the park's coastline would be less than 3 years. This would be a significant effect. However, public perception of damage could last for a greater time.

IV.B.1.r(2) Effects from Exploration

During exploration, no facilities would be placed within any existing park, refuge, recreational area, or other special area. No oil would be produced. Exploration platforms would be brought into the inlet, and offshore support would take place from existing facilities. No effects would be generated that would compromise the scenic and intrinsic values of these special areas.

IV.B.1.r(3) Effects from Development and Production

During construction, a 75-mile-long pipeline would be constructed along the Sterling Highway right-of-way (an oil pipeline in 2010 and a gas pipeline in 2022 [see Section II.B]). This could have an effect on the intrinsic qualities of some State recreation areas. Should this pipeline(s) come onshore near a State recreation area, that area could be disturbed by construction activities and its recreational and intrinsic values degraded. Such an effect can be mitigated or avoided by careful route selection, pipeline burial, and habitat rehabilitation. Direct disruption of a recreation area would last for one to two seasons. Other recreational areas along the Sterling Highway would be available for use during the construction period. However, if not mitigated this recreational area may suffer some long-term effects both from a lessening of intrinsic values and from a public perception that those qualities have been degraded.

In general, State recreational areas that border the Sterling Highway are not expected to suffer any direct effects from pipeline construction. The construction of the pipeline in the highway right-of-way and the location of the recreational areas along the inlet front would tend to preclude any construction-related effects from the Proposed Action.

IV.B.1.r(3)(a) Effects from Routine Operations

Routine oil and gas production operations would affect the parks, refuges, and other special areas adjacent to the sales area predominantly through the small and/or chronic oil spills and fuel spills that might occur during the life of the Proposed Action (based on the oil-spill scenario in Section IV.A.4). These spills generally would be less than 1 barrel and would not be significant enough to degrade the intrinsic and unique visual qualities of the areas under consideration. Oil sheen on the water, tarballs, cleanup equipment and activities, and debris related to the cleanup process would contribute to a lessening of the subject area's aesthetic qualities. However, these effects would be very short term. Cook Inlet is a high-energy area in which small amounts of spilled oil are rapidly dispersed and items such as tarballs moved along or buried by tidal deposits.

A large oil spill and the associated cleanup activities generally would cause the intrinsic values of the parks, refuges, recreational areas, and other special areas discussed in this section to diminish. Potential visitors would avoid them, especially those areas of park and refuge areas that were contacted by pollutants. Private inholdings and lodges serving the general public that are located along the Cook Inlet shore and affected by oil spills would see a significant drop in visitors. Rehabilitation of oiled coastlines and time would restore them to their present quality. Effects would be significant; however, the aesthetics of the area(s) would return to its prespill condition within 3 years. The public's perception of damage, however, might linger for a greater time.

Cook Inlet and Shelikof Strait are areas of high energy. If an oil spill occurred, between 13% and 62% of the oil would be dispersed over a 30-day period, with another third dissipated by evaporation.

Table A.2-6 (annualized conditional probabilities; 30-day contact) shows 13 locations (points) where oil theoretically would be spilled. This table identifies 31 land segments that have a greater than 10% chance of contacting oil by 30 days after the spill. Of these 31 land segments, 24 are national parks, refuges, and recreation areas. Specifically, 12 are along the coastline of the Lake Clark National Park, 10 along the Katmai Park coast, and 2 along the coast of the Kenai Peninsula near State recreation areas. Only LA3 does not result in an individual land segment associated with a park, refuge, or recreation area having a chance of oil contact of 10% or greater.

Table A.2-29 shows the 30-day cumulative probabilities of oil contacting a series of land segments representative of the national parks, refuges, recreational areas, and other special areas. This table indicates that areas other than Lake Clark or Katmai National Parks could be affected by a spill of 1,000 barrels or more. For Katmai, the chance of a spill contacting its shoreline is greater than 25% for 9 of the 13 spill points and greater than 50% for 4 of the 13 spill points. For the Lake Clark National Park, the chance of spilled oil contacting land is greater than 25% from 4 of the 13 spill points. Those same four spill points have a less than 25% chance of contacting the Katmai Park shores. For two of the spill points (LA1 and P1), there is a greater than 50% chance of oil contacting the Lake Clark shoreline. We, therefore, can conclude that if a 1,000-barrel spill occurs, there is a 50 % chance that the shoreline of Katmai would be contacted and a 50% chance that the shoreline of Lake Clark National Park would be contacted.

Table A.2-29 indicates that there is a 20% and 25% chance that oil spilled from P1 and P2, respectively, would contact Kenai Peninsula recreation areas. All other land segment groups have a probability of contact of 9% or less. For effects on both terrestrial and aquatic wildlife that inhabits the coastal regions of these subject areas, please refer to appropriate sections of IV.B.1.

Small offshore oil spills of less than 50 barrels would have no effect on any of the park or recreational resources listed in this section.

Should an oil spill of 2,500 barrels or more occur onshore, its effects on State recreational and/or critical habitat areas that line the coast of the Kenai Peninsula is expected to be minimal. The onshore pipeline would be constructed in a right-of-way located on the east side of the Stirling Highway. The Stirling Highway is constructed with a berm along much of its length. For a spill to reach a recreational area, it would have to flow some 50-100 feet to reach the highway and then would have to overreach it and continue its flow down to the coastline. Considering the properties of liquids and the rapid increase in viscosity that released oil would experience when exposed to ambient air temperatures (especially during winter), it is very unlikely that any oil would reach the coastline. In an extreme case, spilled oil would parallel to the east side of the Stirling Highway where it would either congeal or be absorbed into the soil. Access to certain recreational areas could be curtailed or interrupted due to cleanup and repair activities; however, other recreational areas along the Kenai coast could be found and substituted.

IV.B.1.r(3)(b) Effects from Large Natural Gas Release

An accidental release of natural gas from a gas-well blowout or pipeline rupture would affect only the immediate area of the release and should not cause disturbance to the parks, refuges, and other special areas adjacent to the sales area.

IV.B.1.r(4) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

There would be no differences in effects between Lease Sales 191 and 199 other than the effects being delayed for 2 years.

IV.B.1.r(5) Effectiveness of Mitigation Measures

The information developed by the Protection of Fisheries stipulation could reduce potential conflicts with nonconsumptive values of the areas.

IV.B.1.s. Effects of Sale 191 on Coastal Zone Management

IV.B.1.s(1) Alaska Coastal Management Program

Alaska has a federally approved Coastal Management Plan and can review Federal activities for Federal consistency. Federal consistency is the Coastal Zone Management Act requirement that Federal actions that are reasonably likely to affect any land or water use or natural resource of the coastal zone be consistent with the enforceable policies of a State’s Coastal Management Plan. Section 307 of the Coastal Zone Management Act contains the Federal consistency provisions imposing certain requirements on Federal agencies to comply with enforceable policies detailed in the federally-approved Coastal Management Plans.

- Section 307(c)(1) requires Federal Agencies conducting or supporting activities affecting any land or water use or natural resources of the coastal zone be consistent to the maximum extent practicable with the State’s coastal program.
- Section 307(c)(3)(A) prohibits Federal Agencies from issuing a license or permit for any activity that affects any land use or water use or natural resource of the State’s coastal zone until a State, with a federally-approved Coastal Management Plan, has concurred with, presumed to concur with the applicant’s consistency certification that the activity subject to the license or permit is consistent with its enforceable policies, or until the Secretary of Commerce has overridden the State’s objections to the activity.
- Section 307(c)(3)(B) requires that no Federal license or permit for an activity described in detail in an OCS exploration or development and production plan affecting any land or water use or natural resource of the coastal zone may be approved until a State with a federally-approved Coastal Management Plan, has concurred with, is presumed to concur with the applicant’s consistency certification, or until the Secretary of Commerce has overridden the State’s consistency objections.

All of the alternatives, except Alternative II – No Lease Sale, for both Cook Inlet Sales 191 and 199 assume essentially the same amount of oil and gas. For purposes of review with the Alaska Coastal Management Program and the appropriate district policies, the levels of activity between alternatives and sales are very similar. Therefore, the potential for conflict with coastal management standards and policies essentially is the same. The analysis that follows focuses on the potential for conflict with the Statewide standards in the Alaska Coastal Management Program, and the enforceable policies of the Kenai Peninsula Borough Coastal Management Plan, and the Kodiak Island Borough Coastal Management Plan and does not follow the format used by the other resources evaluated in this section. All activities that affect uses or resources of the coastal zone will be subject to the Statewide standards and relevant district policies of the Alaska Coastal Management Program. The Statewide standards of the Alaska Coastal Management Program and the enforceable policies of the district programs are examined for potential conflicts with the hypothesized activities and effects identified in Sections IV.B.1.a through IV.B.1.s.

This analysis is not a consistency determination pursuant to the Coastal Zone Management Act, nor should it be used as a local planning document. It is highly unlikely that all the events that are hypothesized will occur as assumed in this EIS. The leasing of tracts does not mean that exploration will occur or that commercial discoveries will be made on those tracts. Most tracts leased are never explored, and most discoveries are too small to support commercial development. Changes made by lessees as they explore, develop, and produce petroleum products from leases offered in this sale would affect the applicability of this assessment.

The MMS will prepare a consistency determination for State review later in the presale process. The consistency determination will describe the Statewide standards and district policies pertaining to the proposed OCS sale and associated activities that may have reasonably foreseeable effects on land and water uses and natural resources in the coastal zone and evaluate them relative to potential activities resulting from the proposed sale. Applicants for OCS exploration and development and production plans must prepare a consistency certification for review by the State. This document certifies that all activities described in detail in the plans are consistent with the Alaska coastal management program.

IV.B.1.s(2) Conclusion

No conflicts with the Alaska Coastal Management Program or the related district policies are anticipated. The MMS regulatory requirements and the implementation of the mitigating measures effectively address the consistency of the activities herein hypothesized with the Statewide standards of the Alaska Coastal Management Program and the enforceable policies of the Kenai Peninsula Borough and the Kodiak Island Borough Coastal Management Plans. The Coastal Zone Management Act requires that OCS exploration and development and production plans be consistent with the Alaska Coastal Management Program, including district enforceable policies.

The analysis that follows is common to all alternatives and sales.

IV.B.1.s(3) Potential for Conflict with Alaska's Coastal Zone Management Program

In the following paragraphs, the Statewide Alaska Coastal Management Program standards and district policies of the Kodiak Island Borough and the Kenai Peninsula Borough are related to the potential effects identified throughout Section IV.B.1.s of this EIS. District policies are assessed in conjunction with the Statewide standards most closely associated with those policies.

IV.B.1.s(3)(a) Coastal Development (6 AAC 80.040)

Water dependency is a prime criterion for development along the shoreline (6 AAC 80.040(a)). The intent of this policy is to ensure that onshore developments or activities that can be placed inland do not displace activities that depend on shoreline locations.

State standards also require that the placement of structures and discharge of dredged material into coastal waters complies with the regulations of the U.S. Army Corps of Engineers (6 AAC 80.040(b)). Much of the development hypothesized in the scenario would be subject to U.S. Army Corps of Engineers regulations. None of the projects necessarily is allowed or disallowed under the provisions of the U.S.

Army Corps of Engineers regulations. Site-specific environmental changes pursuant to development would be assessed and permitted, depending on the attendant effects.

In addition, the Kenai Peninsula Borough has four policies addressing coastal development that may be applicable (Kenai Peninsula Borough Coastal Management Plan 2.4 through 2.7). These policies require that projects involving dredging or filling in streams, rivers, lakes, wetlands, or saltwater areas including tidal flats be located, designed, constructed, and maintained in a manner so as to:

- avoid significant impacts to important fish and wildlife habitat;
- avoid significant interference with fish migration, spawning, and rearing as well as other important life-history phases of wildlife;
- limit areas of direct disturbance to as small an area as possible;
- minimize the amount of waterborne sediment traveling away from the dredge or fill site; and
- maintain circulation and drainage patterns in the area of the fill.

The Kodiak Island Borough Coastal Management Plan addresses coastal development in its General Policies (Kodiak Island Borough Coastal Management Plan 5.3.1 – Land and Water Activities). The policy states that activities that are water-dependant and water-related will receive priority for waterfront areas. Uses that are neither of these will be considered in shoreline areas only when no feasible or prudent inland sites are available. The Kodiak Island Borough policy also requires that waterfront facilities be used cooperatively to achieve maximum use of the facilities. In addition, activities on coastal lands must be compatible with adjacent land use to the greatest extent feasible.

The only OCS development or activity hypothesized in the scenarios for Sales 191 and 199 that would require a shoreline location is a landfall site for a pipeline. The Statewide standard on coastal development and the related district policies do not automatically preclude pipeline landfalls.

It is anticipated that such development could occur within the applicable parameters of the Statewide standard and related district enforceable policies. No conflicts are anticipated.

IV.B.1.s(3)(b) Geophysical Hazard Areas (6 AAC 80.050)

The Statewide standard requires coastal districts and State agencies to identify areas in which geophysical hazards are known and in which there is a substantial probability that geophysical hazards might occur. Development in these areas is prohibited until siting, design, and construction measures for minimizing property damage and protecting against loss of life have been provided. The Kenai Peninsula Borough Coastal Management Plan contains five policies that address geophysical hazards. They cover major considerations such as erosion; floodway and floodplain development; landslides, mass wasting (such as slumping or creeping), and avalanches.

The Kodiak Island Borough Coastal Management Plan includes policies (Kodiak Island Borough Coastal Management Plan 5.3.2 – Specific Use Policies) that emphasize coordination among government agencies regarding siting, design, and construction measures relative to geophysical hazards such as seismic, coastal, and seiche (prolonged oscillating wave in a lake, bay, or gulf caused by changes in atmospheric pressure or seismic disturbances such as earthquakes) flooding; landslides and mass wasting hazards; and avalanche and riverine flooding.

Geophysical hazards are described in Section III.A.1. Although earthquakes, shallow faults, volcanoes, tsunamis, seiches, sediment or seafloor instability, gas-charged sediments, and large bedforms are evident in the sale area, the description of the hazards provided in Section III.A.1 indicates that none seems to pose a high degree of risk to any development operation.

The MMS regulations, including the platform verification program, regulate lessees to ensure that geophysical hazards, such as those identified, are accommodated in the exploration and development and production plans that must be approved before lessees may commence activities.

The approval process for exploration and development and production plans will ensure siting, design, and construction measures are taken to minimize property damage and protect against loss of life for all areas, including areas in which geophysical hazards are known or where there is a substantial probability that they might occur. There are no inherent conflicts with the Statewide standard or with the Kenai Peninsula Borough or Kodiak Island Borough policies related to geophysical hazards.

IV.B.1.s(3)(c) Recreation (6 AAC 80.060)

Under this Statewide standard, districts are to designate areas for recreational use and give high priority to maintaining and, where appropriate, increasing public access to coastal water. The Kenai Peninsula Borough Coastal Management Plan contains four policies guiding the location and use of public recreation (Kenai Peninsula Borough Coastal Management Plan 4.1 through 4.4). In addition, the Kenai Peninsula Borough's plan 2.2.1 states that approval for floating facilities will address their potential for conflicts with recreation sites. The Kodiak Island Borough Coastal Management Plan (5.3.2 – Specific Use Policies) contains five policies related to recreational development under the heading, "Recreation, Tourism, and Natural Setting." These policies generally guide the development of recreational sites within the boroughs.

Effects on recreation are identified in Section IV.B.1.n of this EIS. The effects of routine exploration and development activities on private and commercial recreation may arise from space-use conflicts. When activities coincide, the duration normally will be very short. Only one of the policies, Kenai Peninsula Borough Coastal Management Plan Policy 3.4(d)2, deals directly with conflict between other activities and recreational use of designated recreation areas. This policy directs other activities to be conducted to minimize conflicts.

Applicants submitting plans for exploration or development and production for approval by the MMS must certify that activities described in their plan are consistent with the Alaska coastal management program. The State will review the plan and the consistency certification and either concur or object. No activities will be permitted by MMS without State concurrence or a decision by the Secretary of Commerce to override the State's objections. However, given the scenarios and attendant activities hypothesized for Cook Inlet Sales 191 and 199, it is anticipated that conflicts with the Statewide standard and the district-enforceable policies can be avoided.

IV.B.1.s(3)(d) Energy Facilities (6 AAC 80.070)

The State Coastal Management Plan requires that decisions on the siting and approval of energy-related facilities be based, to the extent feasible and prudent, on 16 standards. The following discussion addresses only those that are applicable to the scenarios presented in this EIS. These include pipelines and rights-of-way; drilling rigs and platforms; petroleum separation, treatment, or storage facilities; and oil terminals and other port development for the transfer of energy products (6 AAC 80.900(22)). Moreover, "uses authorized by the issuance of state or federal leases for mineral and petroleum resource extraction are uses of state concern" (6 AAC 80.070 (c)). A district may restrict a use of State concern only if the decision is reasonable and the district has consulted with and considered the views of appropriate agencies, identified reasonable alternative sites, and based its restrictions on analyses that show the proposed use is incompatible with the proposed site (AS 46.40.070 (c)).

The Kodiak Island Borough Coastal Management Plan (Policy 5.3.2 – Energy Facilities) includes 13 policies related to energy facilities. They address compatibility with nearby land and water uses, suitable space for expansion, use of existing facilities, and consideration of commercial-fishing activities. The Kenai Peninsula Borough Coastal Management Plan (Policy 5.0) incorporates 11 policies related to energy facilities. Also, the Kenai plan expands all but three of the Statewide standards to encompass "related activities" in addition to "facilities" (5.1). The Statewide standards require that facilities be sited to:

1. minimize adverse environmental and social effects while satisfying industrial requirements, and
2. be compatible with existing and subsequent uses (6 AAC 80.070(1) and (2)).

Expanding on these points, the Statewide standards further specify that facilities be sited in areas of least biological productivity, diversity, and vulnerability and that areas of particular scenic, recreational, environmental, and subsistence and/or cultural values be protected (6 AAC 80.070 (b)(13), and (12)).

Another Statewide standard requires that facilities be consolidated (6 AAC 80.070(b)(3)). The Kenai Peninsula Borough Coastal Management Plan augments this and requires that "existing industrial facilities or areas and pipeline routes shall be used to meet new requirements for exploration and production support bases, transmission/ shipment (including pipelines and transportation systems), and distribution of energy resources" (Section 5.3). The Kodiak Island Borough Plan Facility Consolidation policy encourages multiple uses for energy facilities. Pipelines are emphasized in this Statewide standard and the Kenai Peninsula Borough Coastal Management Plan. First, the Statewide standard requires that facilities be designed to permit free passage and movement of fish and wildlife with due consideration for historic migratory patterns (6 AAC 80.070 (12)). In addition, the Kenai Peninsula Borough Coastal Management Plan requires that offshore pipelines and other underwater structures be located, designed, or protected to allow fishing gear to pass over without snagging or otherwise damaging the structure or gear (Policy 5.5). Moreover, they shall "be sited designed, constructed, and maintained to avoid important fishing grounds and to minimize risk to fish and wildlife habitats from a spill, pipeline break, or other construction activities. Pipeline crossings of fish-bearing waters and wetlands important to waterfowl and shorebirds shall incorporate mitigative measures, to the extent feasible and prudent, to minimize the amount of oil which may enter such waters as a result of a pipeline rupture or leak" (Policy 5.6). No barriers to migrating fish and wildlife were identified in the resource analyses as a result of development hypothesized in this EIS. As stated in the Kenai Peninsula Borough Coastal Management Plan policy, some mitigation measures will be required to minimize damage; however, nothing in the scenario is inherently in conflict with these policies.

Other siting criteria include (6 AAC 80.070(b)(11)(13)(14)(8)(6)(7), respectively):

- Water discharges and oil spills must be able to be contained and damage to the environment (including fishing grounds, spawning grounds, and other biologically productive or vulnerable habitats such as marine mammal rookeries and hauling out grounds and waterfowl nesting areas) be minimized.
- Winds and air currents must be able to disperse the emissions so Federal and State air-quality regulations are not violated.
- Navigational hazards must be avoided.
- Space must be available for reasonable expansion.
- Sites must either have existing infrastructure or be appropriate for an enclave development.

In addition to oil spills, the Kenai Peninsula Borough Coastal Management Plan (Section 5.2.a) includes drilling wastes and other toxic or hazardous materials as substances that commercial/industrial operations must prevent from contaminating surface and groundwater.

The Kenai Peninsula Borough Coastal Management Plan (Policy 5.9) provides strict guidance for how and when geophysical surveys may occur and be consistent with the plan. "Seasonal restrictions, restrictions on the use of explosives, or restrictions relating to the type of transportation used in such operations will be included as necessary to mitigate potential adverse impacts" (Policy 5.9(a)). In addition, "(v)essels engaged in offshore geophysical exploration will conduct their operations to avoid significant interference with commercial fishing activities" (Policy 5.9 (c)). Section IV.B.1.k of this EIS notes that seismic surveys might exert temporary disturbance/dispersal to fish and thus reduce a harvest. However, this would be limited to the time of the survey, probably no more than 1 hour following passage of the airgun array (several airguns simultaneously releasing differing amounts of compressed air). Seismic surveys that are planned and coordinated with the commercial fishing industry are expected to make conflicts rare to nonexistent.

Construction associated with energy-related facilities resulting from the multiple sales also must comply with siting policies that apply to all types of development. These more general policies are discussed under Habitats and Air, Land, and Water Quality (Section IV.B.1.o).

Stipulation No. 1 - Protection of Fisheries requires that lessees review planned exploration and development activities with directly affected fishing organizations, subsistence communities, and port authorities to avoid unreasonable fishing gear conflicts. This stipulation also requires the lessees to include in their plans a summary of fishing activities in the area of the proposed operation, an assessment of effects, and measures taken by the lessee to prevent unreasonable conflicts. Local communities, including fishing interests will have the opportunity to review and comment on proposed plans as part of the MMS regulatory review process. No conflicts with the Statewide standards or with the Kenai Peninsula Borough and Kodiak Island Borough Coastal Management Plans' related policies on the siting and approval of energy facilities and related activities are anticipated.

IV.B.1.s(3)(e) Transportation and Utilities (6 AAC 80.080)

This Statewide standard requires that transportation and utility routes and facilities in the coastal zone are sited, designed, and constructed to be compatible with district programs. It includes a requirement that routes for transportation and utilities be sited inland from shorelines and beaches unless the route or facility is water-dependent or no feasible and prudent inland alternative exists. Assuming that after an offshore pipeline crossed the beach it would continue inland of the beach, conformance with this Statewide standard is possible.

In addition, the Statewide standard and related district policies identify constraints for the siting, design, construction, and maintenance of transportation and utility facilities. The Kenai Peninsula Borough Coastal Management Plan requires that road, pipeline, and utility crossings of anadromous fish streams be minimized and consolidated at single locations (Kenai Peninsula Borough Coastal Management Plan 6.2.a). Underwater pipelines must be buried or otherwise "allow for the passage of fishing gear, or the pipeline route shall be selected to avoid important fishing areas, and anadromous fish migration and feeding areas" (Kenai Peninsula Borough Coastal Management Plan 6.4.c). In addition, upland "pipelines and utilities shall be installed underground in areas of high recreational or scenic value or intensive public use" (Policy 6.4.b). The Kodiak Island Borough Coastal Management Plan (5.3.2 - Transportation and Utility Routes) has a similar requirement under its Underground Utilities policy - requiring, to the extent feasible, that utilities be installed underground in areas of high recreation or scenic value or intensive public use. Other policies for transportation and utilities are comparable to the Statewide standard and district policies discussed for facility siting, for example, bridges and culverts must allow for free passage and existing corridors must be used to the extent feasible and prudent (Kenai Peninsula Borough Coastal Management Plan policies 6.2.b and 6.4.a and Kodiak Island Borough Coastal Management Plan 5.3.2 - Transportation and Utility Routes, paragraph 4 - Stream Crossings).

Only the location of a landfall is subject to a siting decision; an offshore platform site is determined by the location of the resources and the facilities in Nikiski to which the oil would be piped already exist. Therefore, transportation issues related to the scenario for Sales 191 and 199 are linked to the siting of energy-related facilities that was discussed in conjunction with the previous policy on Energy-Facility Siting.

The Alaska Coastal Management Program Statewide standards and district policies related to energy facilities and transportation and utilities will be helpful in guiding the decision on where to locate a landfall. These decisions will be made at the time plans are submitted for review. The Alaska Supreme Court, in its decision in *Trustees for Alaska v. State, No. 3945,* noted that "until exploration is proposed and, in all likelihood, until and unless a commercially exploitable discovery is made, there will be no occasion for siting, designing or constructing transportation and utility routes." None of the transportation and utility scenarios developed for this EIS are inherently in conflict with the Statewide standard and the associated district policies on Transportation and Utilities.

IV.B.1.s(3)(f) Fish and Seafood Processing (6 AAC 80.090)

This Statewide standard requires districts to identify areas of the coast suitable for the location or development of facilities related to commercial fishing and seafood processing and allows the district to designate such areas. Although this standard relates only to the siting of facilities related to fishing and seafood processing, the district policies related to fisheries are discussed under the this Statewide standard.

The Kodiak Island Borough Coastal Management Plan (Kodiak Island Borough Coastal Management Plan 5.3.2 - Fisheries and Seafood Processing) gives priority to maintenance and enhancement of fisheries when considering shoreline use proposals that might adversely affect fish habitat, migratory routes, and the commercial harvest of fish. Under this policy, the Kodiak Island Borough Coastal Management Plan also requires that development of energy-related facilities include programs to replace fish stock affected by water supply or other aspects of construction and operations.

The Kenai Peninsula Borough Coastal Management Plan Policy 2.3 on Commercial Fishing is addressed as part of the Borough's coastal development policy. This policy requires that, to the extent feasible and prudent, all temporary and permanent developments, structures, and facilities in marine and estuarine waters be sited, constructed, and operated in a manner that does not create a hazard or obstruction to commercial fishing. It also requires that within the marine and estuarine waters of the coastal area, operators of activities relating to oil, gas, and mining exploration and production provide timely written notification to a list of fishing organizations maintained by the Borough to apprise commercial fishing interests of the schedule and location of development activities prior to initiation of the project. The policy requires specific information be included in the notice. The last part of this policy requires that offshore resource exploration and development activities avoid interference with commercial fishing and subsistence activities.

Kenai Peninsula Borough Coastal Management Plan Policy 5.5 addresses Navigation and Commercial Fishing and requires that activities associated with oil and gas resource exploration, industrial development, or production minimize navigational interference and be located or timed to avoid potential damage to fishing gear. Offshore pipelines and other underwater structures must be located, designed or protected so as to allow fishing gear to pass without snagging or otherwise damaging the structure or gear. Kenai Peninsula Borough Coastal Management Plan Policy 7.3 - Maintenance and Enhancement of Fisheries gives priority to fisheries when reviewing proposed projects that might adversely affect important fisheries habitat, migratory routes, and harvest. These policies are further reinforced by the Kenai Peninsula Borough Policy 12.21 on Priority Use of fish and wildlife habitat, Kenai Peninsula Borough Policy 12.3 - Fish Passage, 12.5 on Water Intake Structures and 12.6 on Use of Explosives.

Activities related to exploration and development and production in the Sales 191 and 199 areas will be planned and conducted in consultation with the State and the Kenai and Kodiak Boroughs. Stipulation No. 1 – Protection of Fisheries requires that lessees review planned exploration and development activities with directly affected fishing organizations, subsistence communities, and port authorities to avoid unreasonable fishing gear conflicts. This stipulation also requires the lessees to include in their plans a summary of fishing activities in the area of the proposed operation, an assessment of effects, and measures taken by the lessee to prevent unreasonable conflicts. Local communities, including fishing interests will have the opportunity to review and comment on proposed plans as part of the MMS regulatory review process. Conflict with this Statewide standard and associated district policies is not anticipated.

IV.B.1.s(3)(g) Subsistence (6 AAC 80.120)

Statewide standards guarantee opportunities for subsistence use of coastal areas and resources. Potentially conflicting uses or activities occurring within this designated area may be permitted only after (1) a study is conducted to determine possible adverse effects and (2) safeguards are implemented to ensure continued subsistence use. Both coastal districts have policies that supplement the Statewide standard on subsistence. In addition to the Statewide standard, the Kenai Peninsula Borough Coastal Management Plan contains four policies that address subsistence. These policies ensure that projects and uses in areas traditionally used for subsistence accommodate the use of subsistence resources from planning to operation, minimize adverse effects to subsistence resources and activities, and maintain access to subsistence-use areas (Kenai Peninsula Borough Coastal Management Plan 11.1 through 11.4). The Kodiak Island Borough Coastal Management Plan contains several policies related to subsistence. They include the policy on Resource Protection which state that energy facilities will be sited so that areas having subsistence values will be protected, the policy on Primary Use which recognizes subsistence as a primary use to be protected when coastal development occurs, and the policy on Habitat Management ensures that the subsistence use of resources is a primary use to be managed in accordance with State and Federal laws.

It is anticipated that exploration and development and production activities that may occur as a result of Sales 191 and 199 will proceed within the parameters of the appropriate consistency requirements and will not conflict with the Statewide standard on Subsistence or with the related district policies.

IV.B.1.s(3)(h) Habitats (6 AAC 80.130)

The Statewide standard for habitats contains an overall standard plus policies specific to eight habitats—offshore areas; estuaries; wetlands and tidal flats; rocky islands and sea cliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important upland habitat (6AAC 80.130 a, b, and c). Activities and uses that do not conform to the standards may be permitted if there is a significant public need and no feasible prudent alternatives to meet that need, and all feasible and prudent measures are incorporated to maximize conformance (6AAC 80.030 d).

The Alaska Coastal Management Program Statewide standard for all habitats in the coastal zone requires that habitats "be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources" (6 AAC 80.130 (b)). The offshore habitat is designated a fisheries conservation zone (6 AAC 80.130.(c)(1)). The Kenai Peninsula Borough Coastal Management Plan contains a policy that gives the highest priority to the maintenance and enhancement of fisheries when the districts evaluate projects that may affect fish spawning, migration, rearing, and over-wintering areas (Kenai Peninsula Borough Coastal Management Plan 12.1). Although it is unlikely that an oil spill will affect areas within the Port Graham/English Bay Area Meriting Special Attention (AMSA), the AMSA Plan identifies seven sites that are considered a priority to protect from an oil spill (Port Graham/English Bay AMSA Plan 13.1).

The Kodiak Island Borough Coastal Management Plan (Kodiak Island Borough Coastal Management Plan 5.3.2 - Resource Enhancement and Protection, paragraph 2) echoes the Statewide standard and states that Federal and State regulations shall guide development in anadromous fish streams, near bald eagle nests, and other coastal habitat areas. Under the same policy, paragraph 4 - Natural Processes, the Kodiak Island Borough Coastal Management Plan states that estuaries, tidal flats, wetlands, and lagoons will be managed to assure water flow, natural circulation patterns, and adequate nutrient and oxygen levels. Dredging and filling will not be permitted in these areas unless approved by the Community Development Department, U.S. Army Corps of Engineers, and other appropriate State and Federal agencies. Upland habitats will be managed to retain drainage patterns, prevent excessive runoff and erosion, surface water quality, and natural ground-water recharge areas. The Kodiak Island Borough Coastal Management Plan Fisheries and Seafood Processing policy, paragraph 3 requires that maintenance and enhancement of fisheries be given priority consideration over shoreline use proposals that might adversely affect fish habitat, migratory routes, and the commercial harvest of fish. Paragraph 4 of the same policy requires development of industrial and energy-related facilities to include programs to replace fish stock affected by water supply or other aspects of construction operations.

Analyses in Section IV.B.1 indicate that neither habitat alteration and reduction nor noise and disturbance as a result of routine operations are expected to have long-term effects on lower trophic-level organisms, fishes, birds, marine mammals, endangered and threatened species, or terrestrial mammals. As a result, no conflict is anticipated with Kenai Peninsula Borough Coastal Management Plan policies that address seabird colonies, marine mammal haul outs, bald eagles, and their nest sites (Kenai Peninsula Borough Coastal Management Plan 12.7 and 12.9, respectively).

Drilling discharges associated with the hypothesized activities are not expected to affect fisheries due to the limited area affected near the platform-discharge point. Small amounts of oil may enter the water during routine operations but are not expected to have a measurable effect on the fisheries. Offshore construction, platforms, and pipelines are expected to result in some space-use conflicts; however, these are expected to be few in number and minor in scope. Seismic surveys, planned and coordinated with the commercial-fishing industry, are expected to have a minimal effect.

No spills are expected to occur during exploration. Small spills may occur during development and production, however; these spills are not expected to have a measurable effect on fisheries or habitats. It is unlikely that a large spill (greater than or equal to 1,000 barrels) will occur and no such spill is assumed.

No conflicts with the Statewide standard on Habitats or with the related district policies are anticipated.

IV.B.1.s(3)(i) Air, Land, and Water Quality (6 AAC 80.140)

The Air-, Land-, and Water-Quality standard of the Alaska Coastal Management Program incorporates by reference all the statutes pertaining to, and regulations and procedures of, the Alaska Department of Environmental Conservation as of August 18, 1992.

Both the Kenai Peninsula Borough and the Kodiak Island Borough Coastal Management Plans have policies addressing air and water quality. The Kenai Peninsula Borough Policy 13.1 prohibits disposal in the Borough of hazardous materials, petroleum, or petroleum products unless done at a facility designed and approved for that purpose. The Kodiak Island Borough policy on State-of-the-Art Technology requires use of the most effective technology currently feasible for limiting emissions and effluents, and for handling, cleanup, and disposal of oil and hazardous materials. The Kodiak Island Borough policy on

Wastewater Discharge requires discharges to be limited to areas with adequate flushing action. Discharges must not be in amounts to render water unsuitable for fish survival, industrial cooling, and industrial watering supply purposes. In addition, the Kodiak Island Borough policy on Dredge and Fill requires that coastal development activities minimize adverse impacts on water quality.

Emissions into the air as a result of exploration and development associated with Sales 191 and 199 are not expected to approach the concentrations of criteria pollutants permissible under the air-quality standards. Discharges of drilling muds and cuttings and other discharges associated with exploration drilling are not expected to have any effect on the overall quality of the Cook Inlet water. Produced waters from a production platform would likely be injected into underlying formations. Even if discharged, produced waters would not be expected to degrade the quality of Cook Inlet water.

Only small, accidental oil spills are assumed to occur as a result of development and production. By definition small spills could be almost 1,000 barrels in size, however; the average small spill is a tenth of a barrel. Based on the oil spill scenario in Section IV.A.4, a number of small spills are assumed to occur under Alternative I. Small spills are not expected to have any degradational effect on the overall water quality of Cook Inlet. The MMS estimates the chance of a large spill greater than or equal to 1,000 barrels occurring and entering offshore waters to be 19% over the production life of the field. A spill greater than 1,000 barrels would be accidental in nature and is not considered reasonably foreseeable in the context of the analysis of potential conflicts with ACMP standards.

No conflicts are anticipated with the Air, Land, and Water Quality standard of the Alaska Coastal Management Program or with the related district policies.

IV.B.1.s(3)(j) Statewide Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150)

The Alaska Coastal Management Program Statewide standard requires that coastal districts and appropriate State agencies identify areas of the coast that are important to the study, understanding, or illustration of National, State, or local history or prehistory. Although no disturbance of known sites is likely, previously undiscovered sites and artifacts may be encountered. The Kenai Peninsula Borough Coastal Management Plan requires that the site be protected from further disturbance and the State Historical Protection Office be notified immediately to evaluate the site or artifacts (Kenai Peninsula Borough Coastal Management Plan 14.2). The Kodiak Island Borough Coastal Management Plan policy on Resource Identification requires that sites not already protected be identified and preserved to the extent feasible and prudent.

Section IV.B.1.l and Appendix F of this EIS provide the documentation that is required by the Alaska Supreme Court before the State can proceed with a lease sale (*Trustees for Alaska v. State, No. 3945*, April 23, 1993). In Appendix F, 149 blocks have been identified with a high probability for containing prehistoric resources (Appendix F, Figure F-1).

The regulations in the Code of Federal Regulations that regulate OCS oil and gas activities include specific requirements of lessees planning operations in areas where it is likely that an archaeological resource exists. They also have specific requirements if a lessee should discover any archaeological resource while conducting operations. Compliance with these regulations and the State and district review of plans when they are submitted will assure consistency with this State standard and the related district policies. Nothing in the scenarios for Sales 191 and 199 conflict with the Statewide standard or the district policies.

IV.B.1.s(4) Summary

Many of the Statewide standards and district policies could apply to the hypothetical developments associated with the scenarios for Sales 191 and 199. The analyses in this EIS indicate that activities described in the scenarios can be conducted without conflicting with the Statewide standards of the Alaska Coastal Management Program or the enforceable policies of the district programs. The operating regulations, the MMS operating procedures, and the mitigating measures associated with these sales significantly minimize the potential for conflict between oil and gas industry activities and the Statewide standards of the Alaska Coastal Management Program and the enforceable policies of the Kenai Peninsula Borough and Kodiak Island Borough Coastal Management Plans. The Coastal Zone Management Act, its implementing regulations, and the State of Alaska Statutes and regulations require that all activities described in detail in an OCS exploration and development and production plan be consistent with the Alaska Coastal Management Program, including the district enforceable policies. Conflicts that may arise as specific plans for exploration and development and production are submitted for MMS approval and State consistency certification will be addressed through that process.

IV.B.1.s(5) Difference in Effects from Sale 191 Alternative I Activities Compared to Sale 199 Alternative I Activities, if Any

The potential for conflict with the Statewide standards of the Alaska Coastal Management Program and the enforceable policies of the Kenai Peninsula Borough and Kodiak Island Borough Coastal Management Plan's are the same for both sales and all alternatives: no conflicts are anticipated. Although each of the alternatives would defer portions of the proposed sale areas, activity outside the deferral areas would still be subject to the Alaska Coastal Management Program standards and related district enforceable policies. Activities described in detail on all exploration and development and production plans must be reviewed for consistency with these standards and policies.

IV.B.1.s(6) Effectiveness of Mitigating Measures

Mitigating measures are assumed to be in place for this analysis; the potential for conflict reflects this assumption. Stipulations that will apply to fisheries include Protection of Fisheries, Protection of Biological Resources, Orientation Program, and Transportation of Hydrocarbons. In addition, several ITL clauses advise lessees of the requirements for Bird and Marine Mammal Protection, Sensitive Areas to be Considered in Oil-Spill-Contingency-Plans, Navigation Safety, Offshore Pipelines, and Discharges into the Marine Environment.

The Protection of Fisheries stipulation requires industry to coordinate their activities with participants in commercial, sport, and subsistence fisheries to ensure the prevention of unreasonable conflicts. It requires lessees review plans with potentially affected fishing organizations, subsistence communities, and port authorities to prevent gear conflicts. The Protection of Biological Resources stipulation requires lessees to report areas of biological significance that are discovered during operations to the MMS and make every reasonable effort to preserve and protect the resource. The Orientation Program stipulation requires lessees to conduct orientation programs for all personnel involved in activities. The program must include information on the importance of not disturbing archaeological and biological resources and habitats, including fisheries, and provide guidance on how to avoid disturbance. The program also must address avoid conflicts with subsistence, and commercial fishing activities, and pertinent mitigation. The Transportation of Hydrocarbons stipulation requires the use of pipelines rather than alternative methods of transportation if at all feasible.

The ITL clauses on Bird and Marine Mammal Protection, Sensitive Areas to be Considered in Oil-Spill-Contingency-Plans, Navigation Safety, Offshore Pipelines, and Discharges into the Marine Environment offer further mitigation.

These mitigating measures are effective in reducing the potential for conflicts between the oil and gas activities hypothesized in this EIS and the Statewide standards and district policies of the Alaska coastal management program.

IV.B.2. Alternative II – No Lease Sale

Under this alternative, if neither lease sale is held, the leasing actions proposed in the Cook Inlet multiple-sale EIS would not be approved. Should this occur, no Federal leases would be offered in the Cook Inlet through 2007, and no oil and gas would be developed from any of the blocks considered for leasing in this EIS. The estimated 140 million barrels of oil and 190 billion cubic feet of natural gas would not be produced. No OCS production-related potential oil spills and no OCS production-related effects to the flora, fauna, or the human environment either on or offshore the Cook Inlet coast would occur. Noise, habitat disturbance and alteration, or water discharges and air emissions from the activities associated with potential island and pipeline construction and operation from exploration drilling and development/production operations would not occur. Potential loss to sport fisheries would not occur. The economic benefits, royalties, and taxes to the Federal and State governments would be forgone.

To replace the potential 140 million barrels of oil not developed from this Cook Inlet multiple-sale program, a large portion of the oil likely would be imported from other locations within either Alaska, the United States, or internationally. The associated environmental impacts from producing oil and transporting it to market still would occur. These imports have attendant environmental effects and negative effects on the Nation's balance of trade. No replacement exists for the potential 190 billion cubic feet of natural gas unless local production of natural gas from non-OCS Cook Inlet sources increases, new supplies are imported, or local demand decreases.

A separate decision will be made for each lease sale. Therefore, the No Lease Sale Alternative encompasses not holding Sale 191 or Sale 199 or just one sale, either Sale 191 or Sale 199. If only the first of the two lease sales—Sale 191—is held, the effects would be similar to those described in Section IV.B.1 for the hypothetical scenario, except that two exploration wells from Sale 199 would not be drilled. Similarly, if only the second lease sale—Sale 199—is held, the effects would be similar to those described in Section IV.B.1 for the hypothetical scenario, except that in the two exploration wells from Sale 191 would not be drilled and the effects would be realized later, because activity would not start until 2006. The effects of holding only Sale 199 on each resource area are described in Section IV.B.1.a through IV.B.1.s. In addition, the information that could be derived from the exploration activity from Sale 191 would not be available if that sale is cancelled.

IV.B.2.a. The Most Important Substitutes for Lost Production

The energy that would have flowed into the United States' economy from this development would need to be provided from a substitute source. Possible sources include:

- other domestic oil production
- imported oil production
- other alternative energy sources such as
  - gasohol
  - compressed natural gas
  - electricity
  - imported methanol
- conservation in the areas of transportation, heating, or reduced consumption of plastics
- fuel switching
- reduction in the consumption of energy

If the proposed multiple-sale initiative is denied, substitute energy likely would be a mix of the above sources largely from imported oil production followed by conservation, additional domestic production, and fuel switching.

A paper from the 1997-2002 5-Year OCS Oil and Gas Program entitled *Energy Alternatives and the Environment* (USDOI, MMS, 1996), which is incorporated here by reference, discusses a long list of potential alternatives to oil and natural gas and evaluates their potential to replace a critical part of our Nation's energy sources. The costs and reliability of these alternative sources make them less viable than oil and gas resources. It seems very likely that during the life of this project, oil and gas resources at or above the current levels will be used in the United States and the world to fuel our economies.

That paper also indicates that imports and additional domestic production will replace most of the lost oil production, while conservation and fuel switching will decrease the demand for fuel. Every fuel alternative, however, imposes its own negative environmental effects. The following list shows the approximate percent and quantity we expect would substitute for the lost oil (140 million barrels). The quantity of conservation and fuel switching are in barrels of oil equivalent.

- Additional imports: 88% of the loss of production equivalent to 123.2 million barrels.
- Conservation: 5% of the loss in production equivalent to 7 million barrels.
- Additional domestic production: 4% of the loss in production equivalent to 5.6 million barrels.

- Fuel switching: 3% of the loss in production equivalent to 4.2 million barrels.

IV.B.2.b. Environmental Impacts from the Most Important Substitutes

IV.B.2.b(1) Additional Oil Imports

Energy Alternatives and the Environment (USDOI, MMS, 1996) indicates that if imports are increased to satisfy the demand for oil, the effects to the environment would be similar in kind to those of the Proposal but would happen in a different location. The species of animals and plants affected may be different, depending on the location of the development. Some of these effects still could occur within the United States from accidental or intentional discharges of oil, whether from tanker or pipeline spills. These events would:

- generate greenhouse gases and air pollutants from transportation and dockside activities;
- degrade air quality from emissions of nitrogen oxides and volatile organic compounds;
- degrade water quality; and
- destroy flora, fauna, and water.

Imported oil imposes negative environmental impacts in producing countries and in countries along trade routes. By not producing our own domestic oil and gas resources and relying on imported oil, we are exporting, from a global perspective, at least a sizeable portion of the environmental impacts to those countries from which the United States imports and through or by which our imported oil is transported.

IV.B.2.b(2) Conservation

Substituting energy-saving technology (for example, adding insulation or more efficient engines) or consuming less energy (lowering thermostat settings during the winter; using public transportation rather than private automobiles) will conserve energy. The former will tend to result in positive net gains to the environment but may require additional manufacturing. The amount of gain will depend on the extent of negative impacts from capital-equipment fabrication. Consuming less of an energy service generally would have a positive environmental effect.

IV.B.2.b(3) Additional Domestic Production

Onshore oil production has notable negative impacts on surface water, groundwater, and wildlife. It also can cause negative impacts on soils, air quality, and vegetation and cause or increase noise and odors.

Offshore oil production may result in impacts similar to those of the Proposed Action, but they would occur in a different location. To the extent other offshore production offsets the potential loss of these resources, the effects would be similar to those of the Proposal but would occur in a different location. Offshore activities also may have adverse impacts to subsistence activities, recreation, and tourism.

IV.B.2.b(4) Fuel Switching

Consumers probably could switch to natural gas to heat their homes and businesses or for industrial uses. While natural gas production will create environmental impacts, these impacts will be at a lower level than those impacts normally associated with oil spills. Other alternative transportation fuels may constitute part of the fuel-substitution mix noted here. This mix depends on future technical and economic advances. At this time, no single alternative fuel appears to have the advantage.

IV.B.2.b(5) Other Substitutes

The Federal Government could impose regulations mandating other substitutes for oil. The most likely sectors to target would be transportation, electricity generation, or various chemical processes; however, there are many possibilities. The reader is referred to the paper *Energy Alternatives and the Environment* (USDOI, MMS, 1996), which discusses many of the alternatives at too great a level of detail to reproduce in this report.

If this alternative (No Lease Sale) is adopted or if the project is withdrawn, the projected effects of the Proposal would not occur. Similar effects would occur elsewhere, but they would be in a different location and probably of a different magnitude. Natural resources in the Cook Inlet still would be exposed to other ongoing oil and gas activities in the area, as analyzed in Section V – Cumulative Effects.

IV.B.2.c. Regional Effects of the No Lease Sale Alternative

If this alternative (No Lease Sale) is adopted for both lease sales or if the project is withdrawn, the projected effects of the Proposed Action would not occur. Similar effects would occur elsewhere, but they would be in a different location and probably of a different magnitude. However, natural resources in the Cook Inlet still would be exposed to other ongoing oil and gas activities in the area, as analyzed in Section V, the cumulative impacts. If this ongoing activity did not result in the discovery of additional oil and gas deposits in the area, oil and natural gas would have to be imported into the area for local consumption. Tankering of crude oil could increase and pipeline for transportation of natural gas from sources outside the area may have to be constructed.

IV.B.2.c(1) Economy

Under this alternative, the beneficial economic effects would not be realized. Because the pipeline would not be installed, the Kenai Peninsula Borough would not realize about $2.7 million per year in property tax revenue for 15 years. The State would lose about $1.8 million per year for 15 years. For the Kenai Peninsula Borough during 5 years of exploration, 40 direct, indirect, and induced jobs and $2.8 million in personal income per year would be lost. During 6 years of development, 330 direct, indirect, and induced jobs and $20.4 million in personal income per year would be lost. During 15 years of production, 100 direct, indirect, and induced jobs and $6.5 million in personal income per year would be lost. Comparable figures for the rest of Alaska are 70 total jobs and $4.1 million in personal income per year during development and 20 total jobs and $1.2 million in personal income during exploration. In the exploration and development scenario for Alternative I, exploration activity would occur from 2006-2010, development activity for oil would occur from 2010-2014, and production for oil would occur from 2011-2025. Development activity for gas would occur from 2022-2024, and production of gas would occur from 2022-2033. See Section IV.B.1.j for further explanation and details and methodology used to estimate the economic effects.

IV.B.2.c(2) Natural Gas Production

A recent study of Cook Inlet area natural gas supply and demand indicated that in the absence of new gas discoveries (such as those assumed by the scenario) actions would need to be taken to ensure delivery of natural gas to local consumers (Northern Economics, Inc., 2001). In the short term, meeting peak demand could require development of a gas-storage facility, construction of additional gas-transportation infrastructure, and charging higher rates for peak-use consumption. In the absence of new discoveries and new infrastructure, cutbacks of industrial use may be necessary to meet peak demand. Beyond 2009, the study concluded, without new supplies of natural gas the operation of the LNG plant could be at risk and higher prices could challenge the economic viability of the ammonia plant to compete in the global economy. After 2019, the need for conventionally produced natural gas (that is, from those sources other than coal-bed methane) becomes more critical to meet the average daily demand, even with the addition of new reserves and cessation of industrial use.

IV.B.2.c(3) Local Tankering of Crude Oil

The hypothetical scenario assumes local processing and consumption of the potential production from the lease sales. Foreclosing this source of petroleum to the local market means that the oil must be imported into the area from other locations via tanker. Currently, a 342,000-barrel tanker makes 13-15 trips per year transporting Trans-Alaska Pipeline System (TAPS) petroleum from Valdez to Cook Inlet processing plants. In the absence of local production, importation of TAPS petroleum likely would continue. Given declining local production, importation could increase. The impacts of oil spills from the additional imported oil likely would occur on the shores of Cook Inlet. As evidenced by the Tri-Borough Agreement (see Section II), local values favor reducing reliance on tankers for transportation of oil.

IV.B.3. Alternative III – Lower Kenai Peninsula Deferral

As shown in Figure I.A-1, Alternative III – Lower Kenai Peninsula Deferral would offer for leasing all of the area described for Alternative I except for a subarea—located in the eastern portion of the proposed sale area—offshore of Homer, Seldovia, Port Graham, and Nanwelek. Alternative III would offer 483 whole or partial blocks, comprising 2,337,000 acres (about 945,770 hectares). The areas that would be removed by the Lower Kenai Peninsula Deferral consist of 34 whole or partial blocks, approximately 163,100 acres, which is about 6.5% of the Alternative I area. This option is being analyzed to estimate potential protection of subsistence-use zones and wildlife areas. The resources for this alternative (140 million barrels of oil and 190 billion cubic feet of natural gas) and the exploration and development activities and time frames are the same as for Alternative I – Proposed Action. The Opportunity Index indicates that this deferral area has a very low chance (approximately 1%) of commercial production as a result of this two-sale leasing program. In contrast, the northern part of the Program Area (north of Kachemak Bay) contains 75% of the commercial potential. (See Appendix A for a discussion of the Opportunity Index.) However, while the selection of Alternative III slightly decreases the opportunity of discovering a commercial field, the resources in this area still could be affected by a large oil spill that occurred elsewhere in the sale area.

According to the Oil-Spill-Risk Analysis, Alternative III could alter the chance that an unlikely large oil spill starting at a particular location in LA5 outside the deferral area would contact a certain environmental resource areas or land segments. For example, as illustrated by Table A.2-3, by removing a portion of LA5, this Alternative could reduce the likelihood that the environmental resource areas from Chinitna Bay to Puale Bay (ERA's 2 through 13), South Kalgin (ERA 28), South Shelikof Straight (ERA 29), and Kachemak Bay/Outer Peninsula (ERA 31) would be contacted within 30 days. Similarly, as illustrated by Table A.2-6, by removing a portion of LA5, this Alternative could reduce the likelihood that land segments from Alinchak Bay to Tuxendi Bay (LS's 18-35) and Cape Starikof to Uginak Bay (LS's 45-86) would be contacted within 30 days. This section presents the following information:

- the difference in adverse and beneficial effects between the Lower Kenai Peninsula Deferral and the Proposed Action (Alternative I);
- the resources for which there will be no difference in effects between the Lower Kenai Peninsula Deferral and the Proposed Action; and
- the differences in effects, if any, of the Lower Kenai Peninsula Deferral on resources if the scenario takes place exclusively as the result of Sale 199 (that is, if Sale 191 is not held).

In many cases, the deferral would make a difference in local effects, that is, within the Lower Kenai Deferral Area, even though overall effects within the project area essentially would be the same as those identified in the analysis for Alternative I.

IV.B.3.a. Resources for Which There Would Be a Difference in Effects Between Alternative III and Alternative I

This section describes the substantial differences between Alternative III and Alternative I. Except as noted in this section, the effects from the exploration, development, and production activities would be the same as those described in Alternative I.

IV.B.3.a(1) Endangered and Threatened Species

Deferral of these blocks could avert noise and disturbance impacts to important Steller sea lion terrestrial and aquatic habitat, to historic (and possibly current) beluga whale fall, winter, and early spring habitat, and to humpback whale late spring and summer habitat. It would reduce the chance of exposure from extremely fresh oil to individual sea lions, and possibly humpbacks or beluga whales that might occur there. It removes an area that has a relatively high probability of impacting important habitat for the endangered western stock of the Steller sea lion and impacting probable year-round habitat for the southwest stock of Alaska sea otters.

Deferral of leasing blocks adjacent to the west side of the Kenai Peninsula would help avert potential adverse effects to Steller sea lions from exploration- and development-related noise and disturbance in an aquatic zone within their designated critical habitat. If this area and the Barren Islands leasing blocks were deferred, most of the potential for noise and disturbance impacts to Steller sea lions within their critical habitat (other than areas near Cape Douglas) would be avoided. The effects of such disturbance are unknown, but recent (Bain, 1998) reports indicate that at least some sea lions were observed at received sound levels up to about 170 decibels but were moving away from the airguns at this level. Reporting on results of monitoring during airgun operations that were undertaken as part of earthquake hazard seismic surveys in Puget Sound, Calambokidis and Osmek (1998:10) reported that "Sighting distances from the" seismic vessel "did not show any large area with a clear absence of sightings…". However, they also reported that sighting distances were greater for both harbor seals and California sea lions when seismic operations were underway than when they were not. Sea lions are very vulnerable to disturbance at haulouts. Given the alarming decline in the western population stock of Steller sea lions, it may be prudent to take all possible measures to avert disturbance where possible.

By deferring these blocks, potentially important sources of noise and disturbance to ESA-listed species resident in this area (primarily to Steller sea lions and, to a lesser extent, beluga and humpback whales would be eliminated. If the blocks were leased, noise and disturbance effects would be caused by up to 78 helicopter flights per month and up to 40 round trips per month of support vessels. Seismic-surveying activity, which could go on for months, would occur. Habitat-alteration could include about 50 acres.

Deferral of these leasing blocks also could reduce potential oil-spill impacts to Steller sea lions at Cape Douglas and sea otters from the southwest Alaska stock in Kamishak Bay and adjacent areas of the Alaska Peninsula. While Cape Douglas is not part of the officially designated critical habitat for Steller sea lions, the National Marine Fisheries Service (2001b) considered it as such for the purposes of their recent biological opinion related to the fisheries Fishery Management Plans and authorization of the Bering Sea/Aleutian Islands groundfish fisheries and the Gulf of Alaska groundfish fisheries. There is an important Steller sea lion haulout at Cape Douglas, and information provided by the National Marine Fisheries Service (2001b) indicates that it is likely to be designated as critical habitat in the near future. In May 1989, DeGange et al. (1995) counted 570 sea otters between Cape Douglas and Cape Aklek. Agler et al. (1995) counted 283 sea otters during a winter aerial survey of the western shoreline (within 0.2 nautical miles) of lower Cook Inlet. In the Final (8/20/2002 revision) Stock Assessment for the Southwest Alaska stock of sea otters, the Fish and Wildlife Service (USDOI, Fish and Wildlife Service, 2002b) reported an estimate of 6,918 sea otters for Kamishak Bay (see Table III.B-12). Thus, important habitat for two highly sensitive and currently declining species, one (the sea otter) with demonstrable high vulnerability to oil spills, occurs in the Kamishak Bay Cape Douglas region.

If an oil spill were to occur in LA5, a block representative of the Lower Kenai Peninsula Deferral area, and contact the shoreline within 30 days during the year (annual probabilities), the highest contacts (11%) likely would be to Augustine Island (LS 29) and Cape Douglas (LS 25). Thus, important Steller sea lion habitats and sea otters habitats along the coast of the Cape Douglas and Kamishak Bay are the most likely areas to be contacted by a large oil spill if it occurred in the Lower Kenai Peninsula Deferral area. Deferring leasing of blocks within this area potentially could reduce effects of a spill on sea otters and Steller sea lions and their habitats in the Kamishak Bay/Douglas River area. Obviously, animals inhabiting areas within the deferral would have a reduced risk of contact with extremely fresh oil originating very near to them. Such fresh oil contains highly toxic volatile components. Inhalation of such toxic volatiles is of high risk to all mammals. Available information indicates that inhalation of such volatiles may pose the greatest of the potential risks to large cetaceans from a large or very large spill. Oil spills could occur in lease blocks to the north, west, or south of the Lower Kenai Peninsula Deferral area that would pose equal or greater risk of contacting Steller sea lions and sea otters from the southwest Alaska stock of sea otters in Kamishak Bay and along the coast of the Alaska Peninsula (Table A.2-6, LA's 1, 2, 3, and 4, LS's 24-32). However, by deferring leasing of the Lower Kenai Peninsula Deferral area, one source for oil spills is reduced, and the probability of exposure to extremely fresh oil is reduced for many of the animals within the deferral area.

Deferral of these leasing blocks could also potentially reduce potential impacts on beluga whales from noise and disturbance and from spilled oil originating in the deferral area that traveled north, particularly in the spring, summer, and fall months. Beluga whales have been sighted in many years in Kachemak Bay during the fall, winter, and spring months.

In their comments on our draft EIS for the proposed OCS oil and gas lease sales in Cook Inlet, the NMFS stated that "…it is also evident that the sale area supports feeding aggregations of humpback whales from one or more stocks. NMFS…" has "…observed humpbacks on several occasions feeding near the Kenai Peninsula coastline north and east of Elizabeth Island. We believe this use should be a determining factor in the decision to establish the two deferral alternatives."

In their Biological Opinion issued under Section 7 of the ESA (see Appendix C for the entire text of the opinion), the National Marine Fisheries Service expressed a similar opinion. Regarding the potential for critical habitat of Steller sea lions to be oiled, the National Marine Fisheries Service (2003:35) wrote: "NMFS believes any reasonable measures to prevent these sites from becoming oiled should be adopted by MMS. Towards this end, we are advocating certain deferral areas, as presented in the DEIS , as Conservation Recommendations."

In the Conservation Recommendations, the National Marine Fisheries Service (2003:44) stated:

> MMS should adopt proposed Alternatives II and IV, as presented in the December 2002 DEIS. These alternatives would defer from leasing certain tracts near the Barren Islands and offshore of the lower Kenai Peninsula. The use of the Sale Area by endangered whales and the Steller sea lion increases to the south, and several designated habitats exist within these deferral areas. NMFS believes these deferrals would reduce general disturbance to these species, and lessen the risk to critical habitat due to aircraft noise, geophysical seismic operations, and to an extent, oil spills.

IV.B.3.a(2) Marine and Coastal Birds

Deferral of these leasing blocks could reduce oil-spill impacts to marine and coastal birds, particularly in Kachemak Bay and in waters off the lower Kenai Peninsula. Bird resources in these areas are probably most vulnerable in spring and summer, when waterfowl, seabirds (especially alcids and tubenoses), and shorebirds are present in great numbers, with densities of 200 birds per square kilometer or greater having been recorded in Kachemak Bay (Section III.B.5; Table III.B-9). Although densities are lower in winter, Kachemak Bay is an important wintering area for waterfowl and alcids, and densities of more than 100 birds per square kilometer have been observed. According to the Oil-Spill-Risk Analysis model (Appendix A), the annual conditional probabilities that a large oil spill occurring from either a platform or a pipeline (Table A.2-3) would contact Kachemak Bay and the lower Kenai Peninsula (ERA's 3 and 31) after 30 days range from 1-42%, depending on the source and location of the spill. The highest probabilities of contact to these areas correspond to spills originating within LA5. By removing a portion of LA5, this Alternative could reduce the risk that marine and coastal birds in Kachemak Bay and along the lower Kenai Peninsula would be contacted by fresh oil, because an oil spill would have to occur farther offshore, providing additional time for the oil to weather and for cleanup vessels to reach the spill. Although no exploration or development would occur in the deferral area, vessel and helicopter traffic and pipeline construction would be the same as for Alternative 1.

IV.B.3.a(3) Recreation, Tourism, and Visual Resources

As described in the analysis for Alternative I (Section IV.B.1.m), space-use conflicts may arise between exploration, development, and production activities and tourism and recreation activities. In the Cook Inlet area, these activities usually take place in different locations or at different times. When recreation and tourism activities coincide with routine oil activity, the duration normally is very short. The effect of the deferral comes from moving the potential platform sites and related activities farther offshore. That action would reduce the area of the lower Kenai Peninsula that would be encompassed by the visual resource impact area (within a 5-mile radius of the platform). In addition, the action may reduce visual impacts to passengers and potential space-use conflicts for charter vessels from Homer and Seldovia, which transit the area en route to the Kennedy Entrance, Barren Islands, and Chugach Islands for wildlife viewing. As illustrated by Table A.2-30, by removing a portion of LA5, this Alternative could reduce the likelihood that land segments within Becharof National Wildlife Refuge, Katmai National Park, Lake Clark National Park, Kenai Peninsula recreation areas, the Barren Islands, and Kodiak National Wildlife Refuge would be contacted within 30 days from production platform spill.

IV.B.3.a(4) Archaeological Resources

As described in the analysis for Alternative I (Section IV.B.1.q), archaeological resources could be affected by any activities that cause physical disturbance to the seafloor or coastal areas, such as the placement of rigs and anchors, drilling wells, pipeline construction, and oil-spill cleanup after an unlikely large oil spill. Small oil spills and gas releases are expected to have little effect. As indicated by Map 1, Alternative III eliminates none of the blocks we identified as possibly containing prehistoric archaeological resources. The Alternative does eliminate some blocks identified as possibly containing potential historic resources, specifically, the wrecks of the vessels *Seldovia* and *Dynamite Kid*. Therefore, there would be no difference in potential effects from Alternative I for prehistoric resources. The deferral does protect the potential historic resources; although, if the area was leased, these resources should be detected during the archaeological surveys and avoided during operations. Potential effects to onshore resources from disturbance from oil-spill cleanup activities would not differ from Alternative I.

IV.B.3.b. Resources for Which There Would Be No Difference in Effects Between Alternative III and Alternative I

This section identifies the resources for which no essential difference was found in effects between Alternative III and Alternative I. While the deferral provides a measure of protection to the resources within the deferral area, the overall effects to the Cook Inlet area are essentially the same as those described for Alternative I.

IV.B.3.b(1) Water Quality

The activities associated with petroleum exploitation most likely to affect water quality in the Cook Inlet proposed sales area are essentially identical to those for Alternative I. The permitted, routine discharges associated with oil and gas development and small (less than 1,000 barrels) oil spills are not expected to cause any significant degradation of Cook Inlet water quality. A large spill is unlikely to occur and, if one did occur, it would not significantly degrade water quality. If such a spill did occur in this alternative, it would be unlikely to reach the Lower Kenai Peninsula Deferral area. Circulation in Cook Inlet is counterclockwise, with coastal Kenai current waters entering through the Lower Kenai Peninsula Deferral area and exiting the inlet through Shelikof Strait (see Section III.A.3). Thus, waters in the Lower Kenai Peninsula Deferral area more likely would be affected by upcurrent activities in the coastal Gulf of Alaska to the east of Cook Inlet than by activities in Cook Inlet to the north or west.

IV.B.3.b(2) Air Quality

Because individual air masses move constantly with atmospheric circulation, we expect that the major differences in effects of the different alternatives on air quality would be those in which specific geographic areas could be affected by air emissions. Because these emissions should not be significant other than in extremely localized areas, we conclude that this deferral would not result in significant effects different from or other than those discussed in Section IV.B.1.b.(1). Air-quality effects of all activities under both sales and both deferral alternatives would cause only small increases in the concentrations of criteria pollutants. Concentrations would be within the Prevention of Significant Deterioration Class I (where applicable) and Class II limits and National Ambient Air Quality Standards. Therefore, effects from the Cook Inlet proposed multiple sales would be low.

Air-quality impacts are determined by atmospheric transport and dispersion patterns and the relative locations of the emission sources and receptors (points where impacts are evaluated). These characteristics will vary to some extent in different locations within Cook Inlet. Wind patterns are determined by large-scale circulation systems and by local topography and heat exchange between the atmosphere, ocean, and ice. Atmospheric dispersion patterns also are very complex. Air-quality monitoring results for a project such as the Cook Inlet Proposal are likely to vary from one area to another, depending on local meteorological and topographical conditions. The air quality modeling for OCS Sale 149 and the current modeling specifically for this Cook Inlet multiple-sales Proposal predicted only small impacts. We can reasonably assume that the effects from facilities anywhere in the region would fall within the regulatory standards.

IV.B.3.b(3) Lower Trophic-Level Organisms

The presence of drill platforms in the OCS area near the Lower Kenai Peninsula would cause very little benthic disturbance, as concluded in Section IV.B.1.c. Therefore, their absence from the deferred area would cause very little change. Further, the absence of drill platforms in the deferred OCS area would reduce only slightly the risk that large oil spills would contact the adjacent shoreline, because most spills would drift to the southwest, with or without the deferral. Also, the Lower Kenai Peninsula Deferral would not eliminate the risk entirely, because spills could drift into the area from operations elsewhere in Cook Inlet.

IV.B.3.b(4) Essential Fish Habitat

Effects of development are common to all alternatives, but disturbance can have different effects on essential fish habitat in different regions of lower Cook Inlet and adjoining waters. Dividing this region into eight areas and characterizing the effects of the various alternatives on essential fish habitat of those species that inhabit that locale allows a finer description of the effects of the greatest (though least likely) potential impact, that is, a large oil spill. Map 3 shows the locations of these divisions along east and west lower Cook Inlet; Kamishak Bay; Kennedy Entrance; upper middle and outer Shelikof Strait, and the western coast of Kodiak Island in addition to marine salmon habitats in the Lower Kenai Peninsula Deferral area. Table A.2-32 compares the alternatives, should an oil spill occur. The marine habitat includes the Kenai Peninsula east to Prince William Sound, the outer Kennedy Entrance to the Gulf of Alaska, eastern Kodiak Island to the Gulf of Alaska, and the outer Shelikof Strait east into the southwest Gulf of Alaska. The total essential fish habitat we analyze extends to the limit of the expected outer boundary of the oil-spill-trajectory modeling (but not to the outer boundary of the 200-mile Exclusive Economic Zone). This habitat area is illustrated in Maps 3-10. This deferral does not decrease the maximum risk in the estuarine essential fish habitats, because the highest risk of contact is from oil spills on the east side of lower Cook Inlet (LA2, see Map A-4) or east of the Barren Islands (LA6). In this alternative, the maximum risk remains 44.8% in Kamishak Bay, the Barren Islands, Kennedy Entrance, and the upper Shelikof Strait.

The greatest effect of this deferral on marine waters outside of Cook Inlet is to slightly lower the maximum risk in areas that are already at low risk. Assuming an oil spill occurs, Oil-Spill-Risk Analysis modeling indicates the maximum risk of a summer oil spill contacting the resource area decreases from 3.9% without the deferral compared to 3.1% with the deferral east of the Kenai Peninsula toward Prince William Sound. The maximum risk for a winter oil spill contacting the resource area is reduced from 2% without the deferral to 1.5% with the deferral. The average annual maximum risk of an oil contacting the resource area decreases from 2.9% without the deferral to 2.2% with the deferral.

V.B.3.b(5) Nonendangered Marine Mammals

This alternative would provide for a buffer zone for harbor seals, Southcentral Alaska Sea otters, and other marine mammal coastal habitats along the coasts of the lower Kenai Peninsula. As shown on Map 16, leasing would be deferred near the southern part of the Kenai Peninsula, where harbor seal haulouts occur on the Chugach Islands off the southern tip of the peninsula. This buffer zone near harbor seal and sea otter habitat areas could provide some protection from oil spills for these habitats by eliminating potential platform and pipeline-spill locations from the vicinity.

Assuming an oil spill occurs in LA5 (as representative of the Lower Kenai Deferral Area) and contacts the shoreline within 30 days during the year (annual probabilities), the highest chance of contact (11%) would be to Augustine Island (LS 29) and Cape Douglas (LS 25). Thus, marine mammal habitats along the coast of the Cape Douglas and Kamishak Bay are the most likely habitats to be contacted by an oil spill if it occurred in Alternative III - Lower Kenai Deferral area. Harbor seals, sea otters, and cetaceans that inhabit these coastal areas could be exposed and possibly affected by a spill if it occurred in the Lower Kenai Deferral area. Not leasing the Lower Kenai Deferral area potentially could reduce effects of a spill to harbor seals and other nonendangered marine mammals and their habitats in the Kamishak Bay/Douglas River area. However, potential spills that could occur to the north, west, or south of the deferral area in other lease blocks would pose equal or greater risk of contacting harbor seals, sea otters, and other nonendangered marine mammal habitats in Kamishak Bay and along the coast of the Alaska Peninsula (Table A.2-6, LA1, 2, 3, and 4, LS's 24-3). Conditional oil-spill-contact risks to the Chugach Islands are low at 0.05-2% contact within 30 days (Table A.2-6, LA5, LS 49).

The overall effect on nonendangered marine mammals from an unlikely large oil spill outside the deferral area is an estimated loss of 20-100 harbor seals, and small numbers of cetaceans. Sea otters from the Southcentral Alaska stock in Kachemak Bay and the Kenai Peninsula could be killed if contaminated by oil from an unlikely large spill (greater than 1,000 barrels). Estimates of total expected mortality could vary widely, depending on exactly which areas were contacted and where sea otters were at the time oil came through. This alternative could potentially reduce the risk of an oil spill moving into Kachemak Bay and affecting the local sea otter population. In general, the effect of this alternative is expected to be about the same as under Alternative I for Sales 191 and 199. Total recovery of the affected nonendangered marine mammal populations from these losses likely would take place within less than 5 years. Regional or migrant populations of nonendangered marine mammals that occur within the Cook Inlet Planning Area likely would not be affected by Alternative I under Sales 191 and 199.

Noise and disturbance effects could include temporary displacement within 1 mile of air traffic (caused by up to 78 helicopter flights per month) and vessel traffic (up to 40 round trips per month). Habitat-alteration would include about 50 acres. Effects on terrestrial mammals are expected to be the same as described under Alternative I, because both alternatives are assumed to use the same transportation scenario with the same amount and location of air and vessel traffic and the same onshore-support facilities to be constructed.

IV.B.3.b(6) Terrestrial Mammals

This alternative would provide for a buffer zone for terrestrial mammal coastal habitats along the coasts of the lower Kenai Peninsula. As shown by Map 17, leasing would be deferred near the southern part of the Kenai Peninsula, which contains river otter habitats along the shoreline and some brown bear habitats on the lower Kenai Peninsula. The buffer zone surrounding these areas could provide some protection from oil spills for these habitats by eliminating potential platform and pipeline-spill locations from the vicinity.

The overall effect on terrestrial mammals from an unlikely large oil spill outside the deferral area could be a loss of small numbers of river otters (approximately 10-30), brown bears (approximately 10-30), and deer (greater than 100); such losses are expected to be about the same as under Alternative I. Local recovery of habitats is estimated to take from more than 1 to perhaps 3 years for river otters and brown bears and 1 year for deer. Regional populations of river otters, brown bears, Sitka black-tailed deer, and other terrestrial mammals likely would not be affected by an oil spill or by the exploration and development activities.

Noise and disturbance effects could include temporary displacement within 1 mile of air traffic (caused by up to 78 helicopter flights per month) and vessel traffic (up to 40 round trips per month). Habitat-alteration would include about 50 acres. Effects on terrestrial mammals are expected to be the same as described under Alternative I, because both alternatives are assumed to use the same transportation scenario with the same amount and location of air and vessel traffic and the same onshore-support facilities to be constructed.

IV.B.3.b(7) Fisheries Resources

The Lower Kenai Peninsula Deferral would eliminate any effects due to drilling discharges, offshore construction activities, and seismic surveys within the deferral area. However, as discussed in Section IV.B.1.d (Alternative I), drilling discharges, offshore construction activities, and seismic surveys are not expected to have measurable effects on fish resources anywhere in the proposed sales area. Alternative III would preclude any activity in the deferral area; it is not expected to benefit fish resources measurably over Alternative I. The deferral would remove the chance for a 1,500-barrel platform spill from occurring in LA5. However, the effect of a 4,600-barrel lower Cook Inlet oil pipeline spill for Alternative III is likely to be similar to that discussed for Alternative I, because the deferral area (and other waters to the south) still would be subject to Cook Inlet oil spills originating from outside the deferral area.

IV.B.3.b(8) Economy of Cook Inlet

The economic effects come from the revenues derived from the exploration, development, and production activity, wherever it occurs in the project area. The deferral prevents the activities from taking place in the deferral area. The activities still could occur in other portions of Cook Inlet. As such, Alternative III would generate the same effects as Alternative I - the Proposal. It would generate increases in property taxes for the Kenai Peninsula Borough that would average about 6% above the level of Borough revenues without Alternative III. Alternative III would generate revenue increases to the State of Alaska of less than 0.01% above the level without Alternative III. Total employment and personal income would not increase over the 1999 baseline for the Kenai Peninsula Borough and the rest of Alaska for each of the three major phases of OCS activity: exploration, development, and production.

IV.B.3.b(9) Commercial Fisheries

Alternative III would eliminate any effects due to drilling discharges, offshore construction activities, and seismic surveys within the Lower Kenai Peninsula Deferral area. However, as discussed in Section IV.B.1.k (Alternative I), drilling discharges, offshore construction activities, and seismic surveys are not expected to have measurable effects on commercial fishing anywhere in the sale area. While Alternative III would preclude any activity in the deferral area, it is not expected to benefit commercial fishing measurably over Alternative I. The deferral would remove the chance for a 1,500-barrel platform spill from occurring in LA5. However, the effect of a 4,600-barrel pipeline spill for Alternative III likely would be similar to that discussed for Alternative I since the deferral area (and other waters to the south) still would be subject to Cook Inlet oil spills originating from outside the deferral area.

IV.B.3.b(10) Subsistence-Harvest Patterns

As described in the analysis for Alternative I (Section IV.B.1.l), for the communities in upper Cook Inlet, central Kenai Peninsula, lower Kenai Peninsula, Kodiak Island, and the southern Alaska Peninsula, short-term, local disturbance from routine activities associated with exploration, development, and production could periodically affect subsistence resources and subsistence-harvest patterns, but no resource or harvest area would become unavailable, no resource would experience an overall decrease in population, and no harvest would be curtailed for the harvest season. Construction disturbance and noise briefly could disturb subsistence species that include beluga whales, seals, sea lions, fish, birds, moose, bears, and Sitka black-tailed deer, and only a few actual animals would be temporarily displaced. The deferral could provide some protection from oil spills by eliminating potential platform locations from the vicinity, thus providing a buffer to offshore, nearshore, and coastal subsistence resources and subsistence-harvest areas. Additionally, any potential spill would occur farther offshore and in this way provide additional time for cleanup vessels to reach the spill before it reached these critical-use areas.

By removing the 34 lease blocks from the eastern portion of the sale area offshore of Homer, Seldovia, Port Graham, and Nanwalek, the deferral potentially provides protection for traditional subsistence-use areas and important wildlife concentration areas. The deferral would eliminate any effects from exploration seismic surveys and offshore noise and disturbance effects from construction activities and drilling discharges, in addition to reducing the potential for oil spills occurring in the area. However, as discussed in the analysis for Alternative I, noise and disturbance from these activities would create only local and short-term impacts to subsistence resources and practices. Deferring exploration and development in this area would not reduce effects measurably over Alternative I. The likelihood of a large oil spill would decrease slightly under this alternative. The Alternative III deferral could provide some protection from oil spills by eliminating potential platform and pipeline-spill locations from the vicinity, thus providing a buffer to offshore, nearshore, and coastal subsistence resources and subsistence-harvest areas. Additionally, any potential spill would occur farther offshore and, in this way, provide additional time for cleanup vessels to reach the spill before it reached these critical-use areas. Even though the likelihood of a large oil spill would decrease slightly under this Alternative, overall effects to subsistence resources and harvest patterns are expected to be about the same as described under Alternative I.

IV.B.3.b(11) Sociocultural Systems

While the deferral provides a measure of protection to the resources within the deferral area, the overall effects to the Cook Inlet area would be essentially the same as those described for Alternative I. As described in the analysis for Alternative I (Section IV.B.1.m), exploration, development, and production activities contribute to the continuation of an important, long-time economic characteristic of the area. No qualitatively “new” activities are introduced to the area that would alter existing sociocultural systems. Similarly, the relatively small number of new residents that come to the area should not alter the existing sociocultural systems. Analysis identified no measurable effects to subsistence-harvest resources from routine operations. The sociocultural systems of Native Alaskan villages should not be affected by the unlikely large spill or natural gas release, because the analysis identified no measurable effects to subsistence-harvest resources from these releases. Under Alternative III, deferral of the blocks from mid-Kachemak Bay and offshore the coast from south of Homer to Port Graham reduces the potential for oil-spill effects from potential production sites in the Lower Kenai Peninsula deferral area. That result should reduce, to an unknown extent, threats to subsistence resources and the attendant sociocultural effects to the Native Alaskan communities of Seldovia, Nanwalek, and Port Graham. Moving potential production sites farther offshore also increases the time available to respond to a production spill, should one occur.

IV.B.3.b(12) Sport Fisheries

Alternative III would generate the same effects as Alternative I - the Proposed Action. We anticipate the following effects on sport fisheries from Alternative III for Sale 191. We anticipate some effects from potential spills greater than 1,000 barrels (1,500 barrels or 4,600 barrels). The Oil-Spill-Risk Analysis shows some probability of spilled oil contacting land segments along the western side of the Kenai Peninsula, which would limit the ability of sport halibut and salmon fishers from setting out from oiled locations as long as such locations were oiled. The fishers could use alternate locations, but some of the charter operators would lose business. The loss of business could be $6 million in 2000 dollars if the loss was 20%. Oil contacting the beaches could affect clam gathering, especially for razor clams and other clam types along the east and west sides of Cook Inlet and mussels and steamer clams in small bays off of Kachemak Bay. In any area contacted by oil, populations of the intertidal organisms would be depressed measurably for about a year, and small amounts of oil would persist in the shoreline sediments for more than a decade. Disturbance, displacement, or injury as a result of drilling or seismic activities also would not be measurable. We do not expect that the various effects to sport fisheries taken altogether would cause population-level changes in sport-fisheries resources and, consequently, in sport-fisheries activities.

V.B.4.a(13) Environmental Justice

Environmental justice would be enhanced to the extent that the deferral protects subsistence resources in the area. Overall, effects to subsistence resources and harvest patterns would be expected to be the same as described under Alternative I, because the same transportation and oil-spill scenarios apply.

IV.B.3.b(14) National and State Parks and Special Areas

Alternative III may reduce some effects to park and recreation area resources; however, the effects of this deferral would not substantively change from those forecast for the Proposed Action. The probability of an oil-spill event occurring, the probability of it contacting certain areas, and the effects of spilled oil would be the same as analyzed for the Proposed Action.

IV.B.3.b(15) Coastal Zone Management

Coastal zone management would be unaffected by Alternative III - Lower Kenai Peninsula Deferral, just as it would be unaffected by Alternative I – the Proposed Action. We anticipate no conflicts with the Alaska Coastal Management Program or the related district policies.

IV.B.3.c. Difference in Effects of Alternative III on Sale 199 Activities Compared to Sale 191 Activities, If Any

If the scenario takes place as the result of Sale 199 instead of Lease 191, the activities would be undertaken 2 years later (starting in 2006) but would not differ in location, duration, or magnitude.

Our analysis identified no differences in the effects of Alternative III on Sale 191 activities compared to Sale 199 activities.

IV.B.4. Alternative IV – Barren Islands Deferral

As shown in Figure I.A-1, Alternative IV - Barren Islands Deferral would offer for leasing all of the area described for Alternative I except for a subarea located off of the Barren Islands. Alternative IV would offer 481 whole or partial blocks, comprising 2,342,000 acres (about 947,794 hectares). The areas that would be removed by the Barren Islands Deferral consist of 36 whole or partial blocks, approximately 158,000 acres, about 6.32% of the Alternative I area. The resources for this alternative (140 million barrels of oil and 190 billion cubic feet of natural gas) and the exploration and development activities and timeframes are the same as for the Proposed Action. The Opportunity Index indicates that this deferral area has a very low chance (approximately 1%) of commercial production as a result of this two-sale leasing program. In contrast, the northern part of the program area (north of Kachemak Bay) contains 75% of the commercial potential. (See Appendix A for a discussion of the Opportunity Index.) However, while the selection of this alternative slightly decreases the opportunity of discovering a commercial field, the resources in this area still could be affected by a large oil spill that occurred elsewhere in the sale area.

According to the Oil-Spill-Risk Analysis model, Alternative IV could alter the chance that an unlikely large oil spill starting at a particular location in LA7 outside the deferral area would contact a certain environmental resource area or land segments. For example, as illustrated by Table A.2-3, this Alternative, by removing a portion of LA7, this alternative could reduce the likelihood that the environmental resource areas from Tuxendi Bay to Puale Bay (ERA's 1 through 12), Sutwik Island (ERA 14), Semidi Islands (ERA 16), and Marmot Island (ERA 24) would be contacted within 30 days. Similarly, as illustrated by Table A.2-6, by removing a portion of LA7, this Alternative could reduce the likelihood that land segments from Cape Providence to Chinitna Bay (LS's 13-33), and Seldovia to Karluk Lagoon (LS's 47-88) would be contacted within 30 days.

This section presents the following information:

- The difference in adverse and beneficial effects between the Barren Islands Deferral and the Proposed Action (Alternative I);
- The resources for which there will be no difference in effects between the Barren Islands and the Proposed Action;
- The differences in effects, if any, of the Barren Islands Deferral on resources if the scenario takes place exclusively as the result of Sale 199 (that is, if Sale 191 is not held).

In many cases, the deferral would make a difference in local effects, that is, within the Barren Islands Deferral area, even though overall effects within the project area essentially would be the same as those identified in the analysis for Alternative I.

IV.B.4.a. Resources for Which There Would Be a Difference in Effects Between Alternative IV and Alternative I

This section describes the differences between this alternative and Alternative I. Except as noted, the effects from the exploration, development, and production activities would be the same as those described in Alternative I.

IV.B.4.a(1) Endangered and Threatened Species

Our analyses indicated probable beneficial effects of the Barren Island deferral for several species of marine mammals that are designated as threatened or endangered under the ESA. These include the western stock of Steller sea lions, humpback whales and possibly, but less likely, fin whales, all of which are listed as endangered under the ESA. It is probable that sea lions from the eastern stock also could benefit from deferral of these lease blocks. Another species that could benefit from deferral of these leasing blocks is the Cook Inlet stock of the beluga whales, which currently is a candidate species under the ESA and is listed as depleted under the Marine Mammal Protection Act.

All of the blocks within the Barren Island deferral area lie within the 20-nautical-mile aquatic zone portion of designated Steller sea lion critical habitat (see Map 13). An important sea lion rookery and sea lion haulouts occur at the Barren Islands. These are important terrestrial components of their critical habitat.

Noise and disturbance associated with seismic exploration and oil and gas development conducted in the area of the Barren Islands deferral could affect the behavior of humpback and, less likely, fin whales; could affect their use of feeding areas within or near the deferral area; and, but less likely, could affect their transit to important feeding areas in Shelikof Strait and the western bays of Kodiak Island. The areas within the deferral are especially sensitive with respect to the impacts of noise, other disturbance, and pollution for several reasons. First, they are relatively narrow. Thus, transiting or feeding species are more likely impacted by and can less easily avoid any sound from exploration or drilling (such as seismic exploration) or oil from a large or very large oil spill. In some species of mammals that have been relatively well studied, females, especially those with young, are more sensitive to impacts of disturbance than males. Such differences in sensitivity have been documented, in some instances, for humpback whales. Available data indicate that the areas near the Barren Islands and the related entrances to Cook Inlet are used seasonally, at least in some years, by hundreds of humpback whales, probably for feeding and, for some individuals, for transit to other feeding areas. Secondly and relatedly, these areas funnel nutrients and associated phytoplankton (see Figure III.B-1) and zooplankton into the inlet from the Gulf of Alaska. They are central routes for migratory fish and, in general, are used by high numbers of species that are prey species of endangered and threatened marine mammal species, such as the aforementioned humpback and fin whales, beluga whale, and Steller sea lion.

Biologists with the National Marine Fisheries Service have observed “hundreds” of humpback whales (Sease and Fadely, 2001) in the area near the Barren Islands. A National Marine Fisheries Biologist (B. Smith, cited in State of Alaska, Dept. of Natural Resources, 1999) is reported in Cook Inlet Areawide 1999 Oil and Gas Lease Sale documents as stating that about 60-80 humpback whales have been seen near the Barren Islands but none north of Kachemak Bay. As noted in Section III.B.4 on the affected environment, the humpbacks that feed in Kodiak region may be a distinct feeding aggregation.

Studies in other regions have shown that humpback whale pods with females showed an avoidance response at an estimated 7-12 kilometers from a large seismic source (McCauley et al., 2000). These animals were in what McCauley et al. (2000) termed “key habitat areas.” In these cases, McCauley et al. (2000:692) concluded that “Humpback pods containing cows which are involved in resting behavior in key habitat types, as opposed to migrating animals, were more sensitive….” “Cow/calf pairs are…more likely to exhibit an avoidance response to man-made sounds they are unaccustomed to. Thus any management issues relating to seismic surveys should consider the cow/calf responses as the defining limits” (McCauley et al. (2000:697). These authors also point out that migrating whales should be distinguished from whales that remain in an area for feeding, socializing, or some other purpose. Only localized avoidance was found in their study for migrating whales. In their study, humpbacks on an interception course with a seismic vessel generally maintained their course until at 4-5 kilometers, where they adjusted their course to pass by the vessel at an avoidance range of about 3 kilometers. It is difficult to predict whether humpback whale pods containing females and calves that were transiting to feeding areas, or engaged in feeding near the Barren Islands, would be as likely to show avoidance behavior as the cow/calf pairs in McCauley et al.’s (2000) study. As pointed out elsewhere in this document, numerous factors can affect both sound transmission, detection of a given sound by an individual, and the individual’s response to a given sound. In a study of the potential effects of airgun noise on feeding humpbacks, undertaken in southeast Alaska, Malme et al. (1985:8-1 to 8-2) concluded that:

> Distribution of whale sightings under control and stimulus conditions showed no clear avoidance response. Of the 13 air gun and playback experiments, seven yielded significant differences…of which four were avoidance…. Since we were unable to follow individual whales, we were also unable to test whether a small fraction of the population was particularly sensitive to playback.
>
> Peak-peak levels of the 3-dimensional seismic array measured by McCauley et al. (2000) were 182 decibels re 1 micropascal at 1.6 kilometers, a level below the source level for the highest components of humpback breaching/pec slapping sounds or songs (for example, 192 decibels re 1 micropascal peak). This observation, coupled with observations of singing and breaching of whales in close proximity to other whales, and observations of humpbacks actively using the sound shadow near the surface of the water, led McCauley et al. (2000) to reason that humpbacks probably are not at physiological risk from noise from airguns used in seismic exploration unless at short range from a large array.

While available data indicate that humpback whales regularly occur seasonally and feed near the Barren Islands, sometimes in large numbers, the use of this area by fin whales is less clear. Fin whales can occur in this region, probably feed there, and likely use the entrances for entering and exiting inside waters. Fin whales also occasionally come into the lower Inlet but, based on available information, they are not common in the area. In contrast, the use of the Shelikof Strait region by fin whales appears to be year-round, or nearly year-round. However, it is not clear that the same individuals are staying year-round.

Noise from seismic exploration, shipping, or other actions associated with the proposed sales that originated from blocks in the Barren Island deferral area would be more likely to be detected by cetaceans in the Gulf of Alaska and Shelikof Strait than would noise produced higher in the inlet. Elimination of the blocks in the Barren Islands deferral area could result in a reduction in the amount and level of noise (for example, from seismic exploration, shipping, etc.) detected by any deepwater, large threatened and endangered cetacean in the Gulf of Alaska and in Shelikof Strait. Land is an effective barrier to underwater sound.

In the regions near the Barren Islands, seismic activity or other potential sources of noise and disturbance would be occurring near important historic rookery areas for Steller sea lions and near or within sea lion feeding areas. As noted above, areas within the Barren Island deferral are also used by prey species of Steller sea lions and fin, humpback, and beluga whales. In their Final Biological Opinion regarding the potential for this action to cause adverse effects to or jeopardize the continued existence of species listed under the ESA, the National Marine Fisheries Service (2003:40-41) concluded:

> Sea lions and whales exposed to noise-producing activities most likely would experience temporary, non-lethal effects. Some avoidance behavior could persist up to 12-24 hours. Marine geophysical (seismic) exploration is of particular concern to fin and humpback whales, although any impacts are most likely associated with behavioral changes (harassment) rather than injury or death.

If a large or very large oil spill in the Barren Islands region occurred during the period when large numbers (for example, "hundreds") of humpbacks are feeding, we cannot rule out the possibility that there potentially could be a significant adverse effect on affected population stock(s) of this species. However, as discussed in Sections IV.B.1.f and IV.F.3.f, impacts of oil spills on large cetaceans are difficult to study, and predictions about their behavior after a spill and the outcome of any exposure they might have to oil are both difficult to make. In their Final Biological Opinion regarding the potential for this action to cause adverse effects to or jeopardize the continued existence of species listed under the ESA, the National Marine Fisheries Service (2003:40-41) also concluded:

> Most sea lions and whales exposed to spilled oil are expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey items, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals may be killed as a result of exposure to freshly spilled oil.

In their comments on our draft EIS for the proposed OCS oil and gas lease sales in Cook Inlet, the NMFS (2002:4) stated that

> …it is also evident that the sale area supports feeding aggregations of humpback whales from one or more stocks. NMFS has received many reports of 'several hundred' humpbacks sighted near the Barren Islands by summer fishing charters, and have observed humpbacks on several occasions feeding near the Kenai Peninsula coastline north and east of Elizabeth Island. We believe this use should be a determining factor in the decision to establish the two deferral alternatives.

In their Biological Opinion issued under Section 7 of the ESA (see Appendix C for the entire text of the opinion), the National Marine Fisheries Service expressed a similar opinion. Regarding the potential for critical habitat of Steller sea lions to be oiled, the National Marine Fisheries Service (2003:35) wrote: "NMFS believes any reasonable measures to prevent these sites from becoming oiled should be adopted by MMS. Towards this end, we are advocating certain deferral areas, as presented in the DEIS , as Conservation Recommendations."

In the Conservation Recommendations, the National Marine Fisheries Service (2003:44) stated:

> MMS should adopt proposed Alternatives II and IV, as presented in the December 2002 DEIS. These alternatives would defer from leasing certain tracts near the Barren Islands and offshore of the lower Kenai Peninsula. The use of the Sale Area by endangered whales and the Steller sea lion increases to the south, and several designated habitats exist within these deferral areas. NMFS believes these deferrals would reduce general disturbance to these species, and lessen the risk to critical habitat due to aircraft noise, geophysical seismic operations, and to an extent, oil spills.

Thus, overall, both our analyses and those of the National Marine Fisheries Service (2003) indicated a likely benefit of deferring leasing the Barren Islands deferral lease blocks for several species of marine mammals currently designated as threatened, endangered, or a candidate for listing under the ESA.

IV.B.4.a(2) Marine and Coastal Birds

Deferral of these lease blocks could reduce oil-spill impacts to marine and coastal birds in the Barren Islands area. As discussed in Section III.B.5, the largest concentration of seabirds in the lower Cook Inlet occurs on the Barren Islands, where current estimates indicate that the breeding population may number more than 500,000 birds. At-sea densities of more than 100 birds per square kilometer have been recorded in the area (Table III.B-9). According to the Oil-Spill-Risk Analysis model (Appendix A), the annual conditional probabilities that a large oil spill occurring from either a platform or a pipeline (Table A.2-3) would contact the Barren Islands (ERA 6) after 30 days ranges from less than 0.5% to 44%, depending on the source and location of the spill. By far, the highest probability of contact to this area occurs from a spill originating in LA7. This Alternative, by removing a portion of LA7, could reduce the risk that marine and coastal birds in the Barren Islands area would be contacted by fresh oil, because an oil spill would have to occur farther offshore, providing additional time for the oil to weather and for cleanup vessels to reach the spill. Although no exploration or development would occur in the deferral area, vessel and helicopter traffic and pipeline construction would be the same as for Alternative I.

IV.B.4.a(3) Recreation, Tourism, and Visual Resources

As described in the analysis for Alternative I (Section IV.B.1.m), space-use conflicts may arise between exploration, development, and production activities and tourism and recreation activities. In the Cook Inlet area, these activities usually take place in different locations or at different times. When recreation and tourism activities coincide with routine oil activity, the duration normally will be very short. The effect of the deferral comes from moving the potential platform sites farther offshore. That action reduces the area of the Barren Islands that would be encompassed by the visual resource impact area within a 5-mile radius of the platform. In addition, the action may reduce visual impacts to passengers and potential space-use conflicts for charter vessels from Homer and Seldovia, which transit the area en route to the Kennedy Entrance, Barren Islands, and Chugach Islands for wildlife viewing. As illustrated by Table A.2-30, removing a portion of LA7, this Alternative may reduce the likelihood that land segments within Becharof National Wildlife Refuge, Katmai National Park, Lake Clark National Park, Kenai Peninsula recreation areas, the Barren Islands, and Kodiak National Wildlife Refuge would be contacted within 30 days from production platform spill.

IV.B.4.b. Resources for Which There Would Be No Difference in Effects Between Alternative IV and Alternative I

This section identifies the resources for which, after thorough analysis, no differences were found to exist in effects between this alternative (Alternative IV) and Alternative I - Proposed Action.

IV.B.4.b(1) Water Quality

The activities associated with petroleum exploitation most likely to affect water quality in the Cook Inlet sale area are identical to those for Alternative I - Proposed Action. As for the Proposal, the permitted, routine discharges associated with oil and gas development and small (i.e., less than 1,000 barrels) oil spills are not expected to cause significant degradation of Cook Inlet water quality. A large spill is unlikely to occur and would not significantly degrade water quality if it did occur. If such a spill did occur in this alternative, it would be less likely to reach the Lower Kenai Peninsula Deferral area under this alternative. Circulation in Cook Inlet is counterclockwise, with the coastal Kenai Current waters entering through the eastern portion of the Barren Islands Deferral area and exiting the inlet to the west of the deferral area through Shelikof Strait (see Section III.A.3). Thus, waters in the Barren Islands Deferral area more likely would be affected by upcurrent activities in the coastal Gulf of Alaska to the east of Cook Inlet than by activities in Cook Inlet to the north or west.

IV.B.4.b(2) Air Quality

Because individual air masses move constantly with atmospheric circulation, we expect that the major differences in effects of the different alternatives on air quality would be those in which specific geographic areas could be affected by air emissions. Because these emissions should be significant nowhere other than in extremely localized areas, we conclude that this deferral would not result in significant effects different from or other than those discussed in Section IV.B.1.b.(1). Air-quality effects of all activities under both sales and both deferral alternatives would cause only small increases in the concentrations of criteria pollutants. Concentrations would be within the Prevention of Significant Deterioration Class I (where applicable) and Class II limits and National Ambient Air Quality Standards. Therefore, effects from the Cook Inlet multiple-sale proposals would be low.

Air-quality impacts are determined by atmospheric transport and dispersion patterns and the relative locations of the emission sources and receptors (points where impacts are evaluated). These characteristics will vary to some extent in different locations within Cook Inlet. Wind patterns are determined by large-scale circulation systems and by local topography and heat exchange between the atmosphere, ocean, and ice. Atmospheric dispersion patterns also are very complex. Air-quality monitoring results for a project such as the Cook Inlet Proposal are likely to vary from one area to another, depending on local meteorological and topographical conditions. The air-quality modeling for Sale 149 and the current modeling specifically for this Cook Inlet multiple-sale proposal predicted only small impacts. We can reasonably assume that the effects from facilities anywhere in the region would fall within the regulatory standards.

IV.B.4.b(3) Lower Trophic-Level Organisms

The Barren Islands Deferral area appears to be very productive biologically but, for several reasons, a sale with the Barren Islands Deferral (Alternative IV) would have similar effects on lower trophic-level organisms as leasing the whole area (Alternative I). The high production is indicated by the distribution of phytoplankton chlorophyll (Figure III.B.1). The figure shows that the islands are typically surrounded by water with moderate to very high concentrations of phytoplankton.

There are several reasons why, in spite of the biological production, the effects probably would be the same with or without the deferral. First, the estimated chance of one or more spills greater than or equal to 1,000 barrels would be about the same (see Table A.1-10). Second, the spill risk to the Barren Islands would be about the same with or without the deferral, because any spill from the deferred area would drift mainly to the southwest toward the Alaska Peninsula rather than toward the Barren Islands. Third, offshore facilities in the rest of lower Cook Inlet would pose a very small risk to the Barren Islands, even with the Barren Islands Deferral.

As such, the overall effects on lower trophic-level organisms would be essentially the same as Alternative I. Activities during exploration, development, and production probably would not measurably affect local populations of lower trophic-level organisms. Populations, however, would be affected by very unlikely oil spills and the likely responses to them. We estimate that a 1,500-barrel production platform or 4,600-barrel pipeline spill could contaminate 17-39 kilometers of shoreline in southwestern Cook Inlet and western Shelikof Strait. Local populations of intertidal organisms would be depressed for about a year, and small amounts of oil would persist in shoreline sediments for more than a decade.

IV.B.4.b(4) Essential Fish Habitat

Although the difference between the relative effects of the alternatives is minor, the effects of a large oil spill on essential fish habitat would be the least under the Barren Islands Deferral. Effects would be considered low because, in many cases, habitat would recover within a few weeks to months. Effects of a low-probability large oil spill on the intertidal areas could persist for more than a decade, but fish habitat and populations would be expected to recover. All other effects of exploration and development would be similar to those of Alternatives I and III, because similar levels of exploration and development are expected. Effects from disturbances and seismic activity in both the exploratory and development stages on freshwater and marine fish would be very low.

Removing the area around the Barren Islands in Kennedy Entrance from the sale would slightly decrease the maximum risk of an oil spill affecting the beaches and intertidal areas of Kamishak Bay from 2% without the deferral compared to 1% with the deferral. It would decrease the risk of oil affecting the beach and intertidal areas of the Barren Islands from 7% without the deferral compared to 5% with the deferral. The decreased probability is important in Kamishak Bay, because the largest intertidal areas are located in this section of Cook Inlet. Intertidal damage from a large oil spill, though such a spill is very unlikely, is the potential impact most liable to persist over time.

The Barren Islands Deferral would slightly decrease the probability of oil-spill impacts in the outer Shelikof Strait, which is the estuarine area least likely to be oiled. In the event that a large oil spill should occur, OSRA indicates the maximum risk of a winter oil spill contacting the resource area decreases from 3.1% without the deferral to 2.2% with the deferral. Similarly, the maximum risk of a summer spill contacting a resource area decreases from 1.9% to 1.5%. Thus, the annual maximum average risk of a large spill contacting a resource area is reduced from 2.5% without the deferral to 1.8% with the deferral. The highest probabilities during summer remain unchanged at 46.2% for the Barren Islands, Kennedy Entrance, Western Shelikof Strait, and west of Kodiak Island.

The Oil-Spill-Risk Analysis model indicates that with the deferral area, the maximum risk of contact in Gulf of Alaska marine waters decreases slightly east of Kennedy Entrance from 6.8-3.9% in summer and from 3.8-2.0% in winter. The Kennedy Entrance is an ecologically rich area, because upwelling waters bring nutrients into the marine food chain there. The maximum risk of a large oil spill to the fishes' zooplankton food source and the zooplankton's algae food source in this rich area would be reduced by about 50% with the Barren Islands Deferral. The potential effects of a large oil spill entering waters of the Kennedy Entrance probably would extend from a few days to several weeks, depending on the existing water-circulation patterns; oil is expected to move from the Kennedy Entrance past the Barren Islands along either or both sides of Kodiak Island or back up into Cook Inlet by the Alaska Coastal Current. Some oil may circulate around the Barren Islands due to an apparent gyre there (Figure III.A-5), thereby potentially impacting nearshore and intertidal habitat and prey. Phytoplankton likely would recover more quickly than zooplankton; recovery of zooplankton in marine waters of Kennedy Entrance would occur over a few weeks. Recovery of nearshore and intertidal habitat and prey may last more than a decade. Neritic waters of the Barren Islands are dominated by Pollock, and nearshore habitats are nearly completely populated by Pacific sand lance (Robards et al., 1999). Both species are important forage fish for other fishes, seabirds, and marine mammals in the central Gulf of Alaska.

Similarly, the Oil-Spill-Risk Analysis model indicates that the maximum risk of an oil spill in marine waters east of Kodiak Island in summer also decreases from 1.2% without the deferral to less than 0.5% with the deferral. Although the area east of Kodiak Island is not as ecologically rich as the Kennedy Entrance, it is essential habitat to pollock, sablefish, Atka mackerel, skates, Pacific sand lance, halibut, yellowfin sole, and weathervane scallops.

IV.B.4.b(5) Fisheries Resources

This deferral would eliminate any effects due to drilling discharges, offshore construction activities, and seismic surveys within the deferral area. However, as discussed in Section IV.B.1 (Alternative I), drilling discharges, offshore construction activities, and seismic surveys are not expected to have measurable effects on fish resources anywhere in the sale area. While Alternative IV would preclude any activity in the deferral area, it is not expected to benefit fish resources measurably over Alternative I. Hence, the overall effect of Alternative IV on fisheries resources is likely to be the same as Alternative I (i.e., no measurable effect). A large oil spill associated with Alternative IV (greater than 1,000 barrels) is expected to slightly decrease the risk of potential effects as discussed for Alternative I. See Section IV.B.4.b(4) for additional information.

IV.B.4.b(6) Nonendangered Marine Mammals

This alternative would provide some protection from noise, discharges, disturbance, and oil spills for Barren Islands area harbor seal, Southcentral Alaska sea otter, and other marine mammal habitats, by removing the area from consideration for leasing. In addition, the deferral could protect harbor seal and other nonendangered marine mammal habitats along the coast south of Cape Douglas from an unlikely oil spill. According to the Oil-Spill-Risk Analysis model, the highest chance of contact (13%) is to the Alaska Peninsula south of Cape Douglas (LS 24), assuming an oil spill occurs in LA7 (as representative of the Barren Islands Deferral area) and contacts the shoreline within 30 days during the year (annual probabilities). However, potential spills that could occur outside the deferral area would pose equal or greater risk of contacting nonendangered marine mammal habitats in Kamishak Bay and along the coast of the Alaska Peninsula (Table A.2.-6, LA's 1 through 4 and 6, LS's 24-32). As such, the overall effects to nonendangered marine mammals are essentially the same as those for Alternative I, an estimated loss of 20-100 harbor seals, a few fur seals, and small numbers of cetaceans (10-20). Total recovery of the affected nonendangered marine mammal populations from these losses likely would take place within less than 5 years. Regional or migrant populations of nonendangered marine mammals that occur within the Cook Inlet Planning Area likely would not be affected by Alternative I or Alternative IV. Similarly, noise and disturbance effects would occur elsewhere outside the deferral area and could include temporary displacement within 1 mile of air traffic (caused by up to 78 helicopter flights per month) and vessel traffic (caused by up to 40 round trips per month). Habitat alteration would include about 50 acres.

IV.B.4.b(7) Terrestrial Mammals

This alternative would provide some protection from noise, discharges, disturbance, and oil spills for terrestrial mammals and habitat in the coastal area of the Barren Islands by removing the area from consideration for leasing. In addition, the deferral could reduce the risk to terrestrial mammals and their habitat along the coast south of Cape Douglas from an unlikely oil spill. According to the Oil-Spill-Risk Analysis model, the highest chance of contact (13%) is to the Alaska Peninsula south of Cape Douglas (LS 24), assuming an oil spill occurs in LA7 (as representative of the Barren Islands Deferral area) and contacts the shoreline within 30 days during the year (annual probabilities). However, potential spills that could occur outside the deferral area would pose an equal or greater risk of contacting nonendangered marine mammal habitats in other areas. As such, the overall effects to terrestrial mammals are essentially the same as those for Alternative I, an estimated loss of small numbers of river otters (approximately 10-30), brown bears (approximately 10-30), and deer (more than 100). Local recovery of habitats is estimated to take from more than 1 to perhaps 3 years for river otters and brown bears and 1 year for deer. Regional populations of river otters, brown bears, Sitka black-tailed deer, and other terrestrial mammals likely would not be affected by an oil spill or by the exploration and development activities.

IV.B.4.b(8) Economy of Cook Inlet

The economic effects would come from the revenues derived from the exploration, development, and production activity, wherever it occurs in the project area. The deferral prevents the activities from taking place in the deferral area. The activities still could occur in other portions of Cook Inlet. As such, the Barren Islands Deferral would have the same economic effects as Alternative I - the Proposed Action. It would generate increases in property taxes for the Kenai Peninsula Borough that would average about 6% above the level of Borough revenues without Alternative IV. Alternative IV would generate revenue increases to the State of Alaska of less than 0.01% above the level without Alternative IV. Total employment and personal income would not increase over the 1999 baseline for the Kenai Peninsula Borough and the rest of Alaska for each of the three major phases of OCS activity: exploration, development, and production.

IV.B.4.b(9) Commercial Fisheries

The deferral would eliminate any effects due to drilling discharges, offshore construction activities, and seismic surveys within the Barren Islands Deferral area. However, as discussed in Section IV.B.1 (Alternative I), drilling discharges, offshore construction activities, and seismic surveys are not expected to have measurable effects on commercial fishing anywhere in the sale area. Although Alternative IV would preclude any activity in the deferral area, it is not expected to benefit commercial fishing measurably over Alternative I. Hence, the overall effect of drilling discharges, offshore construction activities, and seismic surveys associated with Alternative IV on commercial fishing is likely to be the same as Alternative I (no measurable effect). The effect of a 4,600-barrel oil spill for this Alternative is likely to be similar to that discussed for Alternative I, because the deferral area (and other waters to the south) still would be subject to Cook Inlet oil spills originating from outside the deferral area. As discussed for Alternative I, the occurrence of a 4,600-barrel oil spill in lower Cook Inlet in spring is estimated to result in a loss to the Cook Inlet commercial-fishing industry of about 22-105% per year for 2 years. Annual losses to the Kodiak commercial-fishing industry are likely to occur over a longer period and may ultimately result in greater losses overall.

IV.B.4.b(10) Subsistence-Harvest Patterns

This deferral could provide some protection from oil spills by eliminating potential platform and pipeline-spill locations from the vicinity, thus providing a buffer to offshore, nearshore, and coastal subsistence resources and subsistence-harvest areas. Additionally, any potential spill would occur farther offshore and, in this way, provide additional time for cleanup vessels to reach the spill before it reached these critical use areas. This deferral also would reduce potential noise and disturbance to critical harbor seal haulouts, Steller sea lion habitat, and possibly to beluga whales passing through Kennedy Entrance.

By removing 36 lease blocks from the southeast portion of the sale area north and west of the Barren Islands, the deferral potentially provides protection for traditional subsistence-use areas and important wildlife-concentration areas. The deferral would eliminate any effects from exploration seismic surveys, offshore noise and disturbance effects from construction activities, and drilling discharges, in addition to reducing the potential for oil spills occurring in the area. However, as discussed in the analysis for Alternative I, noise and disturbance from these activities would create only local and short-term impacts to subsistence resources and practices. Deferring exploration and development in this area would not reduce effects measurably over Alternative I. The likelihood of a large oil spill would decrease slightly under this alternative. The Alternative IV deferral could provide some protection from oil spills by eliminating potential platform- and pipeline-spill locations from the vicinity, thus providing a buffer to offshore, nearshore, and coastal subsistence resources and subsistence-harvest areas. Additionally, any potential spill would occur farther offshore and, in this way, provide additional time for cleanup vessels to reach the spill before it reached these critical-use areas. Even though the likelihood of a large oil spill would decrease slightly under this alternative, overall, effects to subsistence resources and harvest patterns are expected to be the same as described under Alternative I.

IV.B.4.b(11) Sociocultural Systems

Although the deferral provides a measure of protection to the resources within the deferral area, the overall effects to the Cook Inlet area are essentially the same as those described for Alternative I. As described in the analysis for Alternative I (Section IV.B.1.m), exploration, development, and production activities contribute to the continuation of an important, longtime economic characteristic of the area. No qualitatively “new” activities would be introduced to the area that would alter existing sociocultural systems. Similarly, the relatively small number of new residents that would come to the area should not alter the existing sociocultural systems. Analysis identified no measurable effects to subsistence-harvest resources from routine operations. The sociocultural systems of Native Alaskan villages should not be affected by the unlikely large spill or natural gas release, because the analysis identified no measurable effects to subsistence-harvest resources from these releases. Deferral of the blocks around the Barren Islands reduces the potential for oil-spill effects from production sites in the deferral area. This should reduce, to an unknown extent, threats to subsistence resources and the attendant sociocultural effects on the Native Alaskan communities that use the area for subsistence harvest. Moving potential production sites farther offshore also would increase the time available to respond to a production spill, should one occur.

IV.B.4.b(12) Sport Fisheries

The Barren Islands Deferral would generate the same effects as Alternative I - the Proposed Action. We anticipate the following effects on sport fisheries from Alternative IV for Sale 191. We anticipate some effects from potential spills greater than 1,000 barrels (1,500 barrels or 4,600 barrels). The Oil-Spill-Risk Analysis model shows some probability of spilled oil contacting land segments along the western side of the Kenai Peninsula, which would limit the ability of sport halibut and salmon fishers from setting out from oiled locations, as long as such locations were oiled. The fishers could use alternate locations, but some of the charter operators would lose business. The loss of business could be 20%, or $6 million in 2000 dollars, for 1 year. Oil contacting the beaches could affect clam gathering, particularly for razor clams and other types of clams along the east and west side of Cook Inlet and mussels and steamer clams in small bays off of Kachemak Bay. In any area contacted by oil, populations of the intertidal organisms would be depressed measurably for about a year, and small amounts of oil would persist in the shoreline sediments for more than a decade. Disturbance, displacement, or injury as a result of drilling or seismic activities also would not be measurable. We do not expect the various effects to sport fisheries, taken altogether, would cause population-level changes in sport-fisheries resources and, consequently, in sport-fisheries activities.

IV.B.4.b(13) Archaeological Resources

As described in the analysis for Alternative I (Section IV.B.1.q), archaeological resources could be affected by any activities that cause physical disturbance to the seafloor or coastal areas, such as the placement of rigs and anchors, drilling wells, pipeline construction, and oil-spill cleanup after an unlikely large oil spill. Small oil spills and gas releases are expected to have little effect on archaeology resources. As indicated by Map 1, Alternative IV eliminates none of the blocks we identified as possibly containing prehistoric or historic archaeology resources. Therefore, there would be no difference in potential effects from Alternative I.

IV.B.4.b(14) Environmental Justice

Environmental justice would be enhanced to the extent that the deferral protects subsistence resource in the Barren Islands. Overall, effects to subsistence resources and harvest patterns are expected to be the same as described under Alternative I, because the same transportation and oil-spill scenarios apply.

IV.B.4.b(15) National Parks and Reserves, State Parks, and Special Areas

Alternative IV may reduce some effects to parks and recreational area resources; however, the effects of this deferral would not change substantively from those forecast for the Proposed Action (Alternative I). The probability of an oil-spill event occurring, the probability of it contacting certain areas, and the effects of spilled oil would be the same as analyzed for the Proposed Action.

IV.B.4.b(16) Coastal Zone Management

Coastal zone management would be unaffected by Alternative IV - Barren Islands Deferral, just as it is unaffected by Alternative I - Proposed Action. We anticipate no conflicts with the Alaska Coastal Management Program or the related district policies.

IV.B.4.c. Difference in Effects of Alternative IV on Sale 199 Activities Compared to Sale 191 Activities, If Any

If the scenario takes place as the result of Sale 199 instead of Sale 191, the activities would be undertaken 2 years later (starting in 2006) but would not differ in location, duration, or magnitude.

Our analysis identified no incremental differences in the effects of Alternative IV on Sale 191 activities compared to Sale 199 activities.

IV.C. UNAVOIDABLE ADVERSE EFFECTS

This section summarizes the unavoidable adverse effects of Alternative I for Sales 191 and 199. Unavoidable adverse impacts could occur during exploration, development, and production. Many of the adverse effects identified in Sections IV and V of this EIS would occur only if a large (greater than 1,000 barrels) oil spill occurred; however, such an event is unlikely to happen. The effects of large and very large oil spills are discussed in Section IV.B.1 and IV.F but are not included in this analysis, because they are not expected to happen. The following analysis identifies unavoidable adverse effects that are likely occur if Sales 191 and 199 are held as scheduled and result in exploration, development, and production.

IV.C.1. Air Quality

The Cook Inlet multiple-sales Proposal would cause small, local increases in the concentrations of criteria pollutants. Concentrations would be within the Prevention of Significant Deterioration Class I (where applicable) and Class II limits and National Air Quality Standards.

IV.C.2. Fisheries Resources

Drilling discharges, offshore construction, and seismic surveys may affect some fishes, but most are likely to be unaffected. Some adult fishes potentially affected are likely to avoid these activities by moving away from the disturbance stimuli. Such fishes likely would return to the disturbed area shortly after the termination of the disturbance stimuli. Some fishes may incur hearing damage from seismic airguns. Limited numbers of eggs and fry could be harmed or killed due to permitted discharges, construction activities, or small oil spills at levels associated with cohorts or subpopulations, but not at levels or frequencies where there would be measurable effects on overall fish populations. Dispersants and other forms of oil-spill response may produce lethal and sublethal effects in subpopulations of fishes.

IV.C.3. Essential Fish Habitat

Unavoidable effects on essential fish habitat include temporary disturbance from seismic surveys, turbidity resulting from drilling discharges or construction activities, and loss of habitat due to seafloor modification associated with construction activities. Small and somewhat frequent oil spills may degrade or reduce essential fish habitat; however, impacts associated with these spills are limited in scope to subpopulation levels and are not likely to result in a measurable effect to overall fish populations in the region. In situ burning of spills, use of dispersants, and other oil-spill-cleanup activities may compound adverse impacts to essential fish habitat; however, their effects are not likely to measurably impact fisheries populations in the region.

IV.C.4. Endangered and Threatened Species

Unavoidable effects to Steller sea lion critical habitat could result to the extent that unavoidable effects occur to essential fish habitat and on fish prey species in Steller sea lion aquatic foraging areas of critical habitat. Similarly, to the extent that unavoidable effects occur to essential fish habitat and on relevant fish prey species for other ESA-listed species, there could be unavoidable indirect effects on those species.

Based on analyses presented elsewhere, this could result from temporary disturbance from seismic surveys, turbidity during pipeline construction, and loss of habitat due to pipeline construction.

Noise and disturbance from seismic exploration, pipeline and platform construction, development and associated transit may have unavoidable effects on species that move unexpectedly into the areas. For example, as is the case with nonendangered marine and coastal birds, it also is the case that some unavoidable disturbance of small groups of wintering Steller's eiders may occur under helicopter flight paths during inclement weather. They also could be disturbed by support-vessel transit and construction of pipelines, placement of delineation wells, abandonment of delineation wells, etc. We consider this unavoidable, because the birds are mobile and can enter an area where they previously had not aggregated. Construction-related effects on Steller's eiders could be avoided by seasonal restrictions on winter construction activities and by restrictions on activities in areas of known concentrations. Construction-related and disturbance-related effects on other species also could be mostly avoided through seasonal restrictions on certain activities and on avoidance of disturbance activities in areas with known aggregations of endangered and threatened species. For example, restrictions on drilling or other development near the Barren Islands in the summer would mitigate many effects on humpback whales but not on juvenile Steller sea lions.

However, we consider most disturbance of endangered and threatened species associated with routine activities avoidable and expect all activities to comply with prohibitions against take of endangered and threatened species and of destruction, adverse modification, or both of critical habitat protected under the ESA of 1973, as amended. (Prohibitions against take include against harm, harassment, pursuit, wounding, killing, capturing, shooting, collecting, or attempting to do any of the aforementioned.)

Some effects on ESA-listed species that are likely to occur from noise associated with seismic exploration could be avoided through deferral of specific leasing blocks. We also expect disturbance to be minimized through voluntary compliance with the recommendations on aircraft and vessel operation and advisory notes in the proposed ITL on Bird and Marine Mammal Protection and the Proposed ITL on Threatened and Endangered Species.

IV.C.5. Terrestrial Mammals

Habitat alteration effects associated with the construction of onshore facilities are expected to be unavoidable with the long-term displacement of a small number (perhaps fewer than 10) of brown bears and other terrestrial mammals within less than 1 mile of the facilities.

IV.C.6. Marine and Coastal Birds

Most human disturbance of nesting, staging, or migrating marine and coastal birds associated with routine activities is considered avoidable through voluntary compliance with the recommendations on aircraft and vessel operation and advisory notes in the proposed ITL on Bird and Marine Mammal Protection. However, under inclement weather conditions, some disturbance to foraging, nesting, or roosting birds under the helicopter flight path may be unavoidable. A small amount of short-term (a few minutes to a few hours) disturbance, caused by vessel and helicopter traffic and construction activities, of birds present in coastal or marine environments is considered unavoidable.

Because disturbance effects are temporary and mostly avoidable through compliance with the ITL clauses, effects from these factors on marine and coastal birds are likely to be insignificant.

IV.C.7. Subsistence-Harvest Activities

For the communities in upper Cook Inlet, central Kenai Peninsula, lower Kenai Peninsula, Kodiak Island, and the southern Alaska Peninsula, short-term, local disturbance from routine activities associated with exploration, development, and production periodically could affect subsistence resources and subsistence-harvest patterns, but no resource or harvest area would become unavailable, no resource would experience an overall decrease in population, and no harvest would be curtailed for the harvest season. As discussed under routine effects in Section IV.B.1, construction disturbance and noise could briefly disturb subsistence species that include beluga whales, seals, sea lions, fish, birds, moose, bears, and Sitka black-tailed deer, and only a few actual animals would be temporarily displaced. Oil-spill cleanup would increase overall effects by displacing subsistence species, altering or reducing subsistence-hunter access, and altering or extending the normal period of the subsistence hunt. Because disturbance effects are temporary and mostly avoidable through compliance with stipulations and ITL clauses, effects from these factors on subsistence resources and harvest patterns are likely to be insignificant.

IV.C.8. Sociocultural Systems

Changes in subsistence harvest patterns that result from disturbance could create attendant adverse effects to the sociocultural systems of villages and disturb community well being. Given the overarching importance of subsistence resources to maintenance of the village society and Native Alaskan culture, these effects, if they occur, would be considered adverse and unavoidable and in the approximate proportion to the effects on subsistence harvest resources. For example, concerns over tainted foods in communities nearest a small spill could curtail or modify traditional practices for harvesting, sharing, and processing resources and threaten pivotal practices of traditional Native culture—practices only now recovering from the impacts and aftermath of the *Exxon Valdez* oil spill in 1989 (Fall and Utermohle, 1999; Fall et al., 2001). Harvesting, sharing, and processing of subsistence resources would continue but would be hampered to the degree these resources were actually or perceived to be contaminated. Given the effects of the Proposed Action described in Section IV.B.1, chronic effects to subsistence resources and the related effects to sociocultural systems are not likely.

IV.C.9. Recreation, Tourism, and Visual Resources

The adverse effect to visual resources caused by placing a offshore structure within 8 kilometers (5 miles) of a public scenic viewing area, such as a National or State Park, would be unavoidable.

IV.C.10. Archaeological Resources

There may be historic and prehistoric archaeological sites within the proposed sale area. The mitigating measures discussed in Section IV should ensure that archaeological resources are not damaged by sale activities; however, should a significant archaeological resource be damaged or destroyed despite these measures, the loss of archaeological information would be an unavoidable adverse effect.

IV.C.11. Environmental Justice

Potential effects would focus on the Native minority populations residing in the subsistence-based communities of upper Cook Inlet (Tyonek), the central Kenai Peninsula (Ninilchik and the Kenaitze Indian population in Kenai), the lower Kenai Peninsula (Seldovia, Nanwalek, and Port Graham), Kodiak Island (Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions), and the southern Alaska Peninsula (Chignik, Chignik Lagoon, Chignik Lake, Ivanof Bay, and Perryville). Noise and disturbance from routine activities would be unavoidable, but are not expected to produce disproportionate, high adverse Environmental Justice impacts on the Alaskan Native minority populations in these communities.

IV.C.12. Resources for Which Effects Could Be Avoided

Effects to the following resources could be avoided:

- Water quality
- Lower trophic-level organisms
- Nonendangered marine mammals
- Commercial fisheries
- Sport fisheries
- National and State Parks and other special areas
- Coastal Zone Management
- Coastal Zone Management

IV.D. RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

In this section, the short-term effects and uses of various components of the environment of the Cook Inlet Sales 191 and 199 area are related to the long-term effects and the maintenance and enhancement of long-term productivity. The effects of the Proposed Action would vary in kind, intensity, and duration, beginning with preparation activities (such as seismic data collection and exploration drilling) of oil and gas development and ending with the restoration of natural environmental balances.

In general, "short term" refers to the useful lifetime of the proposal, but some shorter-term uses and effects are considered. "Long term" refers to the time beyond the lifetime of the Proposed Action. The overall life of the Proposal under the hypothetical scenario is estimated to be 30 years, including 5 years of exploration (2005-2010), a 23-year period of development and production (2011-2033), and a 2-year decommissioning (2034 and 2035). "Short term" refers to the total duration of the project from exploration to decommissioning whereas "long-term" refers to an indefinite period beyond the termination of oil and gas production.

Many of the effects discussed in Section IV are considered to be short term (being greatest during exploration, development, and early production) and are reduced by the mitigating measures discussed in Section II.F that are considered part of the Proposed Action and alternatives.

Consumption of offshore oil would be a long-term use of nonrenewable resources. Economic, political, and social benefits would accrue from the availability of oil. Most benefits would be short term and would decrease the Nation's dependency on oil imports. Benefits would accrue to the Cook Inlet region.

Alternatives to the Proposed Action—such as cancellation of the lease sales (the No Lease Sale Alternative [II]) and the deferral alternatives (III and IV)—would reduce to varying degrees both the long- and short-term environmental effects as well as the long- and short-term energy benefits.

The overall long-term effect of Sales 191 and 199 would be a small reduction in the productivity of the environment, as described in the following paragraphs.

IV.D.1. Water Quality

Water quality may be affected by exploratory drilling discharges, turbidity from construction activities, and small oil spills. The effects of all these activities on water quality would be short term, with recovering within days or less after the discharge, construction, or spill ceases.

IV.D.2. Air Quality

Air pollution resulting from activities under Alternative I would be a short-term and local effect. The analysis of air-quality effects of the Proposed Action indicates that, although the air quality of the study area may be impaired temporarily and very locally, long-term effects for air quality would be insignificant.

IV.D.3. Lower Trophic-Level Organisms

Lower trophic-level organisms may be affected by drilling discharges, platform and pipeline construction, and oil spills. The effects of most of these activities would be short term with populations recovering within a month from large spills, within a year from drilling discharges, and within 3 years from construction.

IV.D.4. Fisheries Resources

Drilling discharges, offshore construction, and seismic surveys may adversely affect some fishes (i.e., cohorts or subpopulations), but most fishes in Cook Inlet and adjacent waters are likely to be unaffected. Some adult fishes affected are likely to avoid short-term disturbances; eggs, larvae, and juveniles are more susceptible to lethal and sublethal effects. Some fishes may incur hearing damage due to seismic airguns. Some fish could be harmed or killed due to oil spills over the short term. Routine operations and accidental spills, as assumed for the Proposed Action may impact cohorts and subpopulations of fisheries resources; however, these effects would not be measurable at the population level. Hence, these activities are not likely to result in long-term effects on overall fish populations of the central Gulf of Alaska. However, a large or very large oil spill occurring a decade or less before 2035 could produce a long-term impact to fisheries resources in the Cook Inlet region that may require a decade or more to recover from. Please see Section IV.D.5 (Essential Fish Habitat) for added details.

IV.D.5. Essential Fish Habitat

Disturbances associated with construction, seismic surveys, drilling operations, and vessel traffic are expected to be short term with no long-term consequences. Oil spills could have short-term or long-term effects in marine habitats. In the instance of the proposed action, oil spills of the assumed sizes may degrade and reduce EFH and prey cohorts and subpopulations locally but not regionally, and recovery would vary across months and decades (chiefly short-term effects). However, a large or very large oil spill occurring a decade or less before 2035 could produce a long-term effect past the lifetime of the Proposed Action. In the unlikely event of a large or very large oil spill, subpopulations of fisheries resources in the Cook Inlet region could require more than a decade to recover to their original status. The nature and rate of recovering marine communities affected by an oil spill depend on many parameters. Because each situation is unique, the processes of biota (and habitat) recovering in different areas can take very different times, from a few months to decades (Patin, 1999). Species composition and trophic relationships in communities that recover after oil impacts may differ from the original parameters for a long time.

IV.D.6. Endangered and Threatened Species

Potential effects on endangered and threatened species are mostly short term in nature. However, the vulnerable state of many endangered species, particularly those that are in rapid decline, such as the western population of the Steller sea lion, makes definitive classification of any effect that potentially could impact the survival or reproduction of individuals as “short term” problematic. For endangered species that are increasing in abundance and expanding their distribution, this classification is less risky. One can reasonably predict that seemingly minor damage would be repaired in some short period of time. However, for an endangered species that is declining, particularly rapidly, there is no assurance that damage caused by an action can be repaired. In other words, a rapidly declining species already is not repairing much of the damage/loss it is incurring. Thus, it is speculative to assume that it will be able to repair, as individuals or as a population, any damage that the Proposed Action inflicts.

Effects associated with the Proposed Action that could become long term as opposed to short term would include any effects from noise and disturbance to Steller sea lions at terrestrial critical habitats that resulted in mortality (these are avoidable effects, particularly if there is deferral of leasing blocks in the Barren Islands region) and effects of a large or very large oil spill that resulted in significant mortality or injury to Steller sea lions or that resulted in significant decrease in availability of important prey, especially prey to females and juveniles (see Sections IV.D.4 and IV.D.5 for analyses of the potential for fish resources or essential fish habitat to incur long-term effects). The combined probabilities of a large oil spill occurring and impacting Steller sea lions are very low. We do not expect a very large spill to happen at all. Additionally, there are not well-documented serious impacts of oil spills on Steller sea lions. However, there is reason, based on knowledge of oil impacts on mammalian systems and based on the vulnerability of sea lion pups to oil contamination, to consider sea lion mortality from a large or very large oil spill as a potential long-term effect. If a large or very large oil spill occurred in the area of the Barren Islands at a time when hundreds of humpback whales were present, particularly if they were feeding, and caused a significant effect on the exposed populations (see Sections IV.B.1.f and IV.F.3.f for discussion regarding the uncertainty of predictions about probable effects of oil on large cetaceans), and especially if such a spill occurred within a decade of the end of the project, we cannot rule out the potential of a long-term effect on affected populations of humpback whales. If a large or very large oil spill occurred that resulted in the death of large numbers of sea otters from the designated Southwest Alaska stock and/or long-term contamination of important components of their food supply, and, especially if such a spill occurred within a decade of the expected end of the project and the apparent decline of this stock was still occurring, information available from previous oil spills indicates there is the possibility of a long term effect on this designated stock of this species.

IV.D.7. Marine and Coastal Birds

Effects of disturbance on marine and coastal birds are expected to be short term. Marine and coastal birds may experience short-term adverse effects from any factors that disturb their normal daily and seasonal pattern of activities. Of the routine activities associated with this project, helicopters probably have the greatest potential for disturbing marine and coastal birds. Helicopter flights are expected to occur throughout the life of this project. Although much of the potential effect of helicopter flights on birds could be avoided through voluntary compliance with the recommendations on aircraft and vessel operation and advisory notes in the proposed ITL on Bird and Marine Mammal Protection, helicopters may have to fly at low altitudes and cross different parts of the coast under inclement weather conditions. Under these conditions, disturbance of birds under the flight path could occur and continue to occur throughout the life of the project. However, any effects from this disturbance would not extend beyond the life of the project. Minor disturbance effects on marine and coastal birds during construction and from vessel traffic also would be short term and would not extend beyond the life of the project. No loss of marine and coastal bird habitat is expected to occur from this project.

IV.D.8. Nonendangered Marine Mammals

Noise, disturbance, and habitat alteration from offshore construction activities and potential unlikely oil spills temporarily would affect some individual marine mammals and their habitats. These effects are expected to be local. Disturbances and altered habitat possibly could result in local displacement, mortality, or stress of some species or decreases or reductions in local abundance of some species. Effects possibly could last over the long term, if recovery from the short-term effects extended beyond the field’s estimated useful life.

IV.D.9. Terrestrial Mammals

Noise, disturbance, and habitat alteration from onshore construction activities and potential oil spills temporarily would affect some individual terrestrial mammals and their habitats. These effects are expected to be local. Disturbances and altered habitat possibly could result in local displacement, mortality, stress, decreases, or reductions in local abundance of some species. Effects possibly could last over the long term, if recovery from the short-term effects extended beyond the field's estimated useful life.

IV.D.10. Economy

Increases in employment and associated personal income would occur over the life of the OCS activities. Revenue increases to the Kenai Peninsula Borough and the State would occur during production years. However, none of these increases would be long term. Development activity would result in infrastructure that would enhance long-term productivity of oil and gas exploration, development, and production.

IV.D.11. Commercial Fisheries

Routine activities such as drilling discharges, offshore construction, and seismic surveys are not expected to have a measurable effect on commercial fishing in Cook Inlet. However, the occurrence of an unlikely 1,500 or 4,600-barrel oil spill in Cook Inlet during the commercial fishing season could have a substantial short-term effect. Based on the assumptions discussed for Alternative I, losses to the Cook Inlet commercial-fishing industry could range from about 15-65% per year for 2 years following an oil spill in Cook Inlet. Losses to the Kodiak commercial-fishing industry could range from about 5-25% per year for 2 years following the spill. Long-term effects are not likely, because the open ocean typically is oil free soon after an oil spill, fishing typically resumes when the ocean is oil free, and waters not oiled (often the majority of the area) typically are not closed to commercial fishing. If the oil spill did not result in closures of commercial-fishing grounds, it would be expected to have little to no measurable (long- or short-term) effect on commercial fishing in either the Cook Inlet or the Kodiak and Shelikof areas.

IV.D.12. Subsistence-Harvest Patterns

In the short term, redistributing, reducing, tainting, or displacing subsistence species could affect regional subsistence-harvest patterns. Such short-term effects should not have long-term consequences.

IV.D.13. Sociocultural Systems

Alternative I would contribute to the maintenance of a high-value sector of the local economy. Local use of the oil and gas resources developed by the project in the face of locally mature and declining production and an anticipated future increase in demand would sustain and enhance the Cook Inlet area's economic and social stability while reducing the need to import crude oil from outside the area. Furthermore, if additional supplies are discovered and developed, the assumed production system may enhance extraction. The production of oil from the Cook Inlet Sales 191 and 199 area would provide short-term energy needs and possibly provide time for the development of long-term alternative-energy sources or substitutes for petroleum. Regional planning would aid in controlling changing economics and populations and, thus, in moderating any adverse effects.

Short-term effects on subsistence resources that could occur only in the unlikely event of a large oil spill may disrupt the social systems of villages if the effects become chronic over the lifetime of the project. Given the effects of the Proposed Action described in Section IV.B.1, chronic effects to subsistence resources and the related effects to sociocultural systems are not likely.

IV.D.14. Recreation, Tourism, and Visual Resources

No effect between local short term-use and maintenance of long-term productivity is expected for recreation, tourism, and visual resources. Offshore energy facilities and onshore infrastructure would not be sited or operated in a way that interferes with nonfishing coastal-dependent or coastal enhanced recreation and tourist facilities and activities. Offshore infrastructure will be a feature of the visual landscape for the duration of the project. Removal of the structure during decommissioning would remove the feature.

IV.D.15. Sport Fisheries

Section IV.B.1.o explains the short-term effects on sport fisheries. The effects would occur only in the unlikely event of a large oil spill. The Proposed Action would not maintain or enhance long-term productivity.

IV.D.16. Environmental Justice

Short-term effects on subsistence resources that in turn chronically affected the sociocultural system over the lifetime of the project would be considered disproportionate high adverse effects. The effect could occur only in the unlikely event of a large oil spill.

IV.D.17. Archaeological Resources

Archaeological discoveries that may result from surveys required prior to seafloor- or ground-disturbing activities would enhance our long-term knowledge. Overall, such finds could help fill gaps in our knowledge of the history and prehistory of the region and perhaps the country. On the other hand, any destruction of archaeological sites or unauthorized removal of artifacts would represent long-term losses.

IV.D.18. National and State Parks and Other Special Areas

There may be unavoidable short-term effects due to the spillage of oil; however, these effects would be transient and should not affect the long-term use of the national parks, State parks, and special areas.

IV.D.19. Coastal Zone Management

We anticipate no short- or long-term effects to coastal zone management plans as a result of the Proposed Action.

IV.E. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible and irretrievable commitment of resources refers to impacts or losses to resources that cannot be reversed or recovered. This section discusses the irreversible and irretrievable commitment of resources that could occur if Sales 191 and 199 are held as scheduled and result in exploration, development, and production. Many of the adverse effects identified in Sections IV and V of this EIS would happen only if a large (1,000 barrels or more) oil spill occurred, but such an event is unlikely to happen. The effects of large oil spills are discussed in Sections IV.B and are included in this analysis.

IV.E.1. Oil and Gas Resources

We assume that approximately 140 million barrels of oil and 190 billion cubic feet of natural gas could be recovered by the Proposed Action. Should these resources be recovered, they would be irretrievably consumed. In the event of an unlikely large oil spill, the amount of oil spilled would be irretrievably lost.

IV.E.2. Economy

Increases in employment and personal income would occur over the approximate 30-year life of the OCS activities. Revenue increases to the Kenai Peninsula Borough and the State would occur during production years. These would constitute irreversible and irretrievable commitment of resources. Development activity would result in infrastructure, but that infrastructure could be removed.

IV.E.3. Archaeological Resources

Archaeological resources are the material remains of past human activities. Once these vestiges of our heritage as human beings are destroyed, they cannot be renewed or recreated. The mitigating measures discussed in Section IV should ensure that archaeological resources are not damaged by sale activities; however, should a significant archaeological resource be damaged or destroyed despite these measures, the loss of archaeological information would be irreversible and irretrievable.

IV.E.4. Endangered and Threatened Species

For threatened and endangered species, any irretrievable or irreversible commitment of resources important to the long-term survival and recovery of that species probably would violate the intent of the ESA, unless such commitment was made to help protect and aid in the conservation and recovery of that endangered species. Just as with nonendangered marine and coastal birds, it is possible that habitats used by endangered birds, particularly the Steller's eider for wintering and foraging, could be irretrievably or irreversibly altered by activities associated with petroleum exploration and development. Small portions of feeding areas, for example, could be covered by a pipeline, or destroyed by sedimentation related to platform or pipeline construction. However, as long as the area modified is not critical habitat for that species, and is easily replaced by multiple alternate and sufficient locations to permit recovery, any effects are expected to be local, short-term, and insignificant to the recovery of the population. In this case, any such loss of feeding habitat would be expected to be very local and, in some cases, potentially could be avoided by careful placement of development. Because alternate habitat areas for important activities are available and disturbance effects would be temporary, no irretrievable or irreversible effects on endangered and threatened birds from these factors are likely. Just as with the nonendangered coastal and marine birds, collision of staging or migrating birds with offshore or onshore structures related to the proposed OCS oil and gas lease sales may result in the death of a few individuals. However, in the case of endangered and threatened species, if it became apparent that such take was occurring regularly, modifications would need to be made to ensure that significant and irretrievable or irreversible loss does not occur or result in further population decline.

For species such as the North Pacific right whale, any predicted mortality might become an irreversible and irretrievable loss. Significant loss from the endangered, declining western population of Steller sea lions could result in an irreversible loss, but such a level of impact is not expected. If such losses were expected from an action, the action would be in violation of the ESA. With regards to proposed Sales 191 and 199, no such losses are expected or could reasonably be predicted to occur.

The MMS has concluded consultation with the National Marine Fisheries Service and the Fish and Wildlife Service under Section 7 of the ESA. Pertinent documents and correspondence are included in Appendix C. In their Biological Opinion, the National Marine Fisheries Service concluded "…that leasing and exploration are not likely to jeopardize the continued existence of the Steller sea lion, or fin and humpback whales, nor result in the adverse modification of critical habitat." The National Marine Fisheries Service also concurred that other threatened and endangered species under their jurisdiction were unlikely to be adversely affected. In their March 21, 2003, memorandum, the Fish and Wildlife Service concluded that the "…probability of leasing or exploration having an adverse effect upon" Steller's eiders "…is discountable and that the candidate population of sea otters "…would not be jeopardized ad a result of this proposed action." The Fish and Wildlife Service did not consider it necessary to consult on any other listed or recently delisted species. These opinions are in agreement with our conclusion that no irreversible and irretrievable loss is expected for any threatened or endangered species.

IV.E.5. Marine and Coastal Birds

It is possible that habitats used by marine and coastal birds for nesting, staging, or foraging could be irretrievably or irreversibly altered by activities associated with petroleum exploration and development, and there may be some localized but temporary disturbance effects on birds. However, there are alternate habitat areas available in which these activities may take place, and disturbance effects are expected to be temporary. Collision of broodrearing, staging, or migrating birds with offshore or onshore structures could result in the death of a few individuals. Given the limited number of structures assumed to be installed or constructed as a result of the proposed project (for example, one production platform), such losses are not expected to have an irreversible effect on the regional population trends of any species. Because alternate habitat areas for exploration and development activities are available and disturbance effects would be temporary, no irretrievable or irreversible effects on marine and coastal birds from these activities are likely. Although losses of individual birds through collision mortality are irretrievable, such losses are not expected to have an irreversible effect on regional populations.

IV.E.6 Nonendangered Marine Mammals

General development activities, such as increase in human populations and other land-based activities, could displace some nonendangered marine mammals (such as harbor seals) from important habitats to less favorable environments. This eventually could result in reduced population levels or result in changes in distribution. This displacement could become irretrievable, if changes in the environment and habitat were permanently altered by oil and gas leasing activities. Such effects likely would not occur for Sales 191 and 199 under Alternative I or under the other alternatives.

IV.E.7 Terrestrial Mammals

General development activities—such as an increase in human population and other land-based activities—could displace some terrestrial mammals (such as brown bears and river otters) from important habitats to less favorable environments. This eventually could result in reduced population levels or result in changes in distribution. This displacement could become irretrievable, if changes in the environment and habitat were permanently altered by oil and gas activities. Such effects likely would not occur for Sales 191 and 199 under Alternative I or under the other alternatives.

IV.E.8 Other Resources

For the following resources, effects of routine activities from Alternative I would be avoidable, temporary, or would not result in measurable effects at the population level. As such, there is no irretrievable or irreversible commitment for the following resources:

- Water quality
- Air quality
- Lower trophic-level organisms
- Essential fish habitat
- Fisheries resources
- Commercial fisheries
- Subsistence-harvest patterns
- Sociocultural systems
- Recreation, tourism, and visual resources
- Sport fisheries
- National and State parks and other special areas
- Coastal zone management
- Environmental Justice

IV.F. LOW-PROBABILITY, VERY LARGE OIL SPILL

IV.F.1. Introduction

A very large oil spill is an issue of concern to everyone. We define a very large oil spill as greater than or equal to 120,000 barrels of oil. A very large oil spill is a low-probability event with the potential for very high effects. In this section, we analyze the potential effects to resources from an oil spill in lower Cook Inlet. Very large spills happen infrequently, and we have limited historical data for use in our statistical analysis and predictive efforts.

The largest spill from a blowout in Federal waters is 80,000 barrels. One other spill greater than 50,000 barrels has happened since offshore drilling began in the United States. Because there are no spills greater than 100,000 barrels in U.S. waters from platforms, we must look elsewhere for data on spills of that size. Therefore, we use worldwide historical spill data to estimate the chance of very large spills occurring. The spill information we use is based on spills from other countries that do not have the regulatory standards that are enforced on the OCS. In addition, some drilling practices used elsewhere either are not practiced here or are against OCS regulations.

From 1979 through 2000, five oil-well blowouts greater than or equal to 10 million gallons (238,000 barrels) have occurred worldwide (Cutter Information Corporation, 1997; DeCola, 2001). Five of the blowouts greater than 10 million gallons (approximately 238,000 barrels) mostly were the result of either war or drilling practices that oil companies do not now use and may not use under MMS regulations in the United States. During this same time period, there were roughly 470,506 billion barrels of oil produced worldwide (British Petroleum, 2001; *Statistical Review of World Energy, 2001* and earlier issues). These data provide a rate of about 0.01 blowouts greater than or equal to 10 million gallons per billion barrels produced. If this rate is applied to Alternative I for Sales 191 or 199, the estimated probability of one or more oil spills of 10 million gallons (238,000 barrels) is 0.0046, or 0.5%.

Scandpower (2001) recently completed a blowout-frequency assessment of Northstar in the Beaufort Sea of Alaska. This analysis modified statistical blowout frequencies to reflect specific conditions and operating systems at Northstar for the drilling process. The estimated blowout frequency for drilling into the oil-bearing zone and spilling greater than 130,000 barrels is 9.4×10^{-7}.

There have been three blowouts in Cook Inlet, all of them gas. No large oil spills have occurred from blowouts in Cook Inlet. The two most recent are the 1985 blowout at the Grayling Platform and the 1987 blowout at the Steelhead platform. Appendix A contains additional details regarding the gas blowouts in Cook Inlet.

IV.F.2. Effects to Resources from a 120,000-Barrel Blowout Oil Spill

In this EIS, we analyze the potential effects of a spill of 120,000 barrels from a production facility on sensitive resources in the Cook Inlet region. We derive this spill size from industry's estimate of greatest possible discharge from a blowout using the largest flow rate in upper Cook Inlet.

Industry estimates the largest flow rate in Cook Inlet is 8,000 barrels per day from the King Salmon platform. Unocal, Forest Oil Corporation, Phillips 66, Marathon Oil Company, and XTO Energy Inc. provide an estimate of the greatest possible discharge that could occur from a blowout in the *Oil Discharge Prevention and Contingency Plan* for their facilities in Cook Inlet (Unocal Alaska, 2001; Forest Oil Corporation, 2001; Phillips 66, 1998; Marathon Oil Company, 1998; and XTO Energy Inc., 2001). The State of Alaska requires this estimate for a response planning standard under 18 AAC 75.430. Table IV.F-1 shows the response planning standards for blowouts listed in the various company oil discharge prevention and contingency plans.

IV.F.2.a. Blowout Assumptions

We assume a blowout would occur from Cook Inlet production facility and release crude oil into the environment for 15 days. This time period is chosen based on the typical time oil-industry response-planning standards submitted to the State of Alaska under 18AAC.75.430 (Table IV.F-1). The two general environments into which the oil would discharge are broken ice and open water.

The following blowout assumptions are from generalized scenario information. A blowout spill rises into the air at an average rate of 330 barrels per hour. Oil droplets fall to the platform facility and surrounding area. Approximately 25% of the 120,000 barrels evaporates into the air, leaving 90,000 barrels on the platform facility's surface and surrounding area (Table IV.F-2).

Within 15 days from the start of the spill:

- negligible amounts of oil remain on the platform facility,
- 45,000 barrels drain from the facility into the environment, and
- 45,000 barrels fall from spray to the surrounding environment.

Of the oil falling to the surrounding environment:

- the oil is sprayed from the platform in the direction the wind is blowing
- the oil moves up or down the inlet with the tidal currents.

We assume a blowout occurs in LA2. This launch area is nearest to existing facilities and infrastructure. Currently, there is oil industry activity in this area. It is likely that development may begin in the area first, if development occurs at all.

IV.F.2.b. Behavior of Spills in Open Water

This scenario assumes oil would drain from the platform facility into open water. Oil also would fall to open water adjacent to the platform facility. The oil would move with the currents and the winds. The fate of an open-water spill is shown in Tables IV.F-3 and IV.F-4. Table IV.F-5 shows our estimate of the length of coastline oiled. This estimate is the entire discontinuous length of coastline oiled. The entire length is not oiled; rather, portions of the land segment here and there are oiled.

IV.F.2.c. Behavior of a Spill in Broken Ice

Broken ice occurs in the lower Cook Inlet during fall and winter on the northern and western portions. This scenario assumes that oil would drain from the platform facility into broken ice and would fall to the broken ice in a scattered pattern. The ice would contain the oil somewhat and reduce spreading. Unless the oil is frozen into the ice, the evaporation rate would not change. Dispersion and emulsification rates are lower in broken ice than in open water.

During winter freezeup, the oil would freeze into the grease ice and slush before ice sheeting occurs. Winds and storms could break up and disperse the ice and oil until the next freezing cycle. These freezing cycles can be hours or days

In late spring and summer, the unweathered oil would melt out of the ice at different rates, depending on when the oil was frozen into the ice. In Cook Inlet's first-year ice, most of the oil spilled at any one time would percolate up to the ice surface over about a 10-day period. About mid-March, the oil pools would drain into the water among the floes of the broken ice. Thus, in first-year ice, oil would be pooled on the ice surface for up to 30 days before being discharged from the ice surface to the water surface. The pools on the ice surface would concentrate the oil, but only to about 2 millimeters thick, allowing evaporation of 25% of the oil, the part of the oil composed of the lighter, more toxic components of the crude. By the time the oil is released from the melt pools on the ice surface, evaporation has almost stopped, with only an additional 7% of the spilled oil evaporating during an additional 30 days on the water. Tables IV.F-6 shows specific estimates of the fate of a spill into broken ice. Table IV.F-5 shows our estimate of the length of coastline oiled.

IV.F.2.d. The Chance of an Oil Spill Contacting Resources of Concern

We estimate how much oil would reach specific shorelines or other environmental resources from the conditional probabilities for a spill from the production facility. For a full discussion of the Oil-Spill-Risk Analysis model and how we derive the oil-spill modeling simulations and supporting tables, see Appendix A.

Tables IV.F-7 and IV.F-8 summarize the conditional probabilities that a spill starting at a production facility in LA2 would contact individual land segments or environmental resources, 3, 10, and 30 days during the entire year, summer or winter.

IV.F.3. Analysis of Impacts to Each Resource from a 120,000-Barrel Blowout Oil Spill

IV.F.3.a. Water Quality

IV.F.3.a(1) Conclusion

In the very unlikely event of a 120,000-barrel blowout, water column concentrations of dispersed oil could be greater than the 15 parts per billion total hydrocarbon chronic criterion over 5,800 square kilometers for more than 30 days (but for less than 60 days). Concentrations of dispersed oil would not exceed the 1,500 parts per billion acute criterion.

IV.F.3.a(2) Effects of a 120,000-Barrel Blowout

The concentrations of oil in the water from longer-term spills such as the 15-day, 120,000-barrel spill considered in this section are more difficult to project than for shorter-term or instantaneous spills analyzed for water quality in Section IV.B.1.a. The estimation procedures and models used to calculate weathering and spreading in Tables IV.F-3, IV.F-4, and IV.F-6 are better fitted to shorter-term spills. For a 15-day spill, the additional dilution and mixing caused by adding only a fraction of the oil each day to a moving slick on moving water is underestimated. In Tables IV.F-3 and IV.F-6, per note 1, by the time all the oil has been weathered for at least 3 days, oil has been spreading in the water for 18 days, or over somewhere between 1,400-5,800 square kilometers per Table IV.F-4.

To overcome, this difficulty, this analysis makes the following approximation. The amounts of dispersed oil assumed in the calculations are those from Tables IV.F-3 and IV.F-6 multiplied by the fraction of weathering days divided by the 15 days of spillage. For example, Table IV.F-3 lists 11,000 barrels of oil dispersed after 3 days. Thus, the 11,000 barrels is multiplied by the fraction 3 days/15 days, giving 2,200 barrels as the amount expected to be dispersed in the water 3 days into the spill (rather than 3 days after the spills ceases).

With the approximation, 3 days into a 120,000-barrel blowout in winter or summer, the discontinuous surface area of the slick would be 70 square kilometers, and 0.6-1.8% of the total spill volume would be dispersed into the water column. Ten days into the blowout, the discontinuous surface area of the slick would be 1,400 square kilometers and 3-14% of the total spill volume would be dispersed into the water column. Thirty days after the blowout started (15 days after it ceased), the discontinuous surface area of the slick would be 5,800 square kilometers and 8-44% of the spill volume would be dispersed into the water column. Sixty days after the blowout started, the discontinuous surface area of the slick would be 14,000 square kilometers and no more than 44% of the spill volume would be dispersed into a sixty-foot water column.

Based on the assumptions used to estimate the dispersed oil concentration for spills in Section IV.B.1.a, the concentration of dispersed oil after three days is estimated to be 317 to 1000 parts per billion. After ten days, the concentration of oil dispersed into the water is estimated to be 45-190 parts per billion. After 30 days, the concentration of oil dispersed into the water is estimated to be 9-48 parts per billion. After 60 days, the concentrations of oil dispersed into the water is estimated no more than 10 parts per billion.

Note that Cook Inlet crude is highly amenable to decomposition by resident microbes in the water column. Kinney, Button, and Schell (1969) found that oil-oxidation by microbes was the primary removal process for Cook Inlet crude spilled or discharged in Cook Inlet, with the process essentially complete within 1-2 months. This biological removal rate was much faster than tidal flushing in Cook Inlet, which was calculated at 90% flushing of waterborne contaminants in 10 months (Kinney, Button, and Shell 1969, 1970).

The concentration of oil (1) from the *Argo Merchant* (National Research Council, 1985) spill ranged from 90 to 170 parts per billion at the surface and up to 340 parts per billion in the water column (at several of the sampling stations, the concentrations were uniform to water depth of 20 m) and (2) from the *Amoco Cadiz* (Gundlach et al., 1983) spill ranged from 2 to 200 parts per billion in the nearshore area and 30 to 500 parts per billion in the estuaries. The *Argo Merchant* and *Amoco Cadiz* spills (National Research Council, 1985) were larger than the spill assumed in this section; 0.18 and 1.6 million barrels, respectively.

The calculated decrease in dispersed oil concentrations and relationship to chronic and acute criteria are also consistent with both Trustee and industry measurements of total napthalenes (a different measure of oil contamination or toxicity) in the *Exxon Valdez* oil spill (Neff and Stubblefield, 1995; Short and Harris, 1996). In that spill, no open-water samples contaminated by *Exxon Valdez* exceeded the chronic total aromatic hydrocarbon criterion of 10 parts per billion. However, note that water sampling did not start until about the fifth day of spill. Concentration trends with time of sampling presented in Neff and Stubblefield suggest potential for concentrations to have exceeded chronic but not hundredfold higher acute criteria sooner after the spill.

Thus the calculated, high concentrations of oil associated with estimating dispersal in the water column may represent an upper range of dispersed oil concentrations reached during the first several days following a 120,000-barrel blowout. These concentrations are greater than the 15 parts per billion total hydrocarbon chronic criterion over 5,800 square kilometers for more than 30 days (but for less than 60 days), but never exceed the 1,500 parts per billion assumed acute criterion.

IV.F.3.b. Air Quality

IV.F.3.b(1) Conclusion

The effects on air quality, except for their magnitude, do not depend on the size of the spill. These effects are discussed in Section IV.B.1.b(3)(b)1). A very large oil spill, while very unlikely, could cause an increase in the concentrations of gaseous hydrocarbons (volatile organic components) due to evaporation from the spill. The effects would be low. Concentrations of criteria pollutants would remain well within Federal air-quality standards. The overall effects on air quality would be minimal.

IV.F.3.b(2) Effects of a 120,000-Barrel Blowout

Sources of air pollutants related to OCS operations are accidental emissions resulting from gas or oil blowouts, evaporation of spilled oil, and burning of spilled oil. Typical emissions from OCS accidents consist of hydrocarbons (volatile organic compounds); only fires associated with blowouts or oil spills produce other pollutants, such as nitrogen oxides, carbon monoxide, sulfur dioxide, and particulate matter. (See supporting materials and discussions in Section IV.B.1.b. Although that section discusses the effects of a very large spill from a tanker, the effects of a spill from a blowout would be essentially the same as those from a tanker spill.)

IV.F.3.b(2)(a) How Cleanup of a Very Large Blowout Oil-Spill May Affect Air Quality

Operators would be required to emphasize that they would mechanically contain and clean up oil spills to the maximum extent possible. This cleanup of a very large oil spill would require the operation of some equipment, such as boats and vehicles. Emissions from their operation would include nitrogen oxides, carbon monoxide, and sulfur dioxide. Contingency plans would discuss the decision process for in situ burning. If some spilled oil should be burned, the burning would release pollutants. Please see the discussion in Section IV.B.1.b(3)(b)2) for further details.

IV.F.3.b(2)(b) Effects of Accidental Emissions

A discussion of the effects of a gas blowout or oil fire associated with an accidental spill is contained in Section IV.B.12(3) of the final EIS for Sale 144 (USDOI, MMS, Alaska OCS Region, 1996), which we incorporate here by reference. Soot is the major contributor to pollution from a fire. This soot, which would cling to plants near the fire, would tend to slump and wash off vegetation in subsequent rains, limiting any health effects. We expect accidental emissions to have little effect on onshore air quality.

IV.F.3.c. Lower Trophic-Level Organisms

IV.F.3.c(1) Conclusion

A 120,000-barrel spill, while very unlikely, probably would affect 2-15% of the plankton, 80-100% of the intertidal and shallow subtidal benthic populations adjacent to the sale area, and less than 15% of the subtidal benthos adjacent to the sale area. Recovery would take up to 2 weeks for plankton, up to 3 years for marine plants and invertebrates in high-energy habitats, and more than a decade in some subtidal and intertidal habitats.

IV.F.3.c(2) Effects of a 120,000-Barrel Blowout

The effects of a 120,000-barrel spill, while very unlikely, probably would be two or three times greater than the effect of the high-case, 50,000-barrel oil spill that was assessed in the previous Cook Inlet EIS (USDOI, MMS, Alaska OCS Region, 1995:Section IV.B.11.b [4]). The previous EIS concluded that the high-case spill was estimated to have sublethal and lethal effects on 1-5% of the plankton and 40-60% of the intertidal and shallow subtidal marine plants and invertebrates in the sale area. It also concluded that less than 5% of the subtidal benthic populations in the sale area would be affected. Therefore, a 120,000-barrel spill probably would affect 2-15% of the plankton, 80-100% of the intertidal and shallow subtidal benthic populations adjacent to the sale area, and less than 15% of the subtidal benthos adjacent to the sale area. Even though large areas would be affected by a 120,000-barrel spill, the persistence of the effects of the spill probably would be similar to the persistence of a 50,000-barrel spill. The previous EIS estimated that recovery would take up to 2 weeks for plankton and that recovery of marine plants and invertebrates would take up to 3 years in high-energy habitats and up to 7 years in low-energy habitats. Ongoing studies of the *Exxon Valdez* oil spill in Prince William Sound (www.oilspill.state.ak.us) show that recovery in some subtidal and intertidal habitats takes more than a decade.

IV.F.3.d. Fisheries Resources

IV.F.3.d(1) Conclusion

The occurrence of a 120,000-barrel oil spill, while very unlikely, very well could cause significant impacts to fisheries resources of the central Gulf of Alaska. If the spill occurs during winter, 505 and 568 kilometers of the coastline of Cook Inlet and Shelikof Strait may be oiled 10 and 30 days, respectively, after introduction of the oil to the environment. An estimated 399 and 430 kilometers of coastline may be oiled within 10 and 30 days, respectively, of an oil spill occurring in summer. Further coastline of Cook Inlet and Shelikof Strait may be oiled in subsequent weeks following those estimated for the initial 30 days. Early life-history stages of finfishes and shellfishes are the most likely to be affected. Forage fishes such as Pacific herring and walleye pollock most likely would suffer significant impacts due to the coastal spawning habits of adults or the use of pelagic nursery areas. Effects to forage fish populations may persist from oil trapped in subtidal and intertidal sediments for more than a decade, thereby impacting additional cohorts and generations. Such effects may result in important impacts to other species of fisheries resources, seabirds, and marine mammals, thereby altering ecosystem dynamics and community structure. Some salmonid and shellfish subpopulations may experience significant declines within Cook Inlet and Shelikof Strait that collectively lead to measurable and significant impacts in the overall population, requiring multiple generations to recover to their former status.

IV.F.3.d(2) Effects of a 120,000-Barrel Blowout

A blowout at a Cook Inlet production facility is assumed to introduce crude oil into Cook Inlet for 15 days, resulting in a 120,000-barrel oil spill. Such a spill introduced from LA 2 is estimated to result in 5,800 and 14,000 square kilometers of discontinuous oiled areas 30 and 60 days, respectively, following the spill (Table IV.F-4). Portions of the spilled oil would evaporate, disperse within the water column, settle to the seafloor, or oil coastlines (Table IV.F-6). If the spill occurs during winter, 505 and 568 kilometers of the coastline of Cook Inlet and Shelikof Strait may be oiled 10 and 30 days, respectively, after introduction to the environment (Table IV.F-5), and additional coastline may be oiled in subsequent weeks. An estimated 399 and 430 kilometers of coastline may be oiled within 10 and 30 days, respectively, of an oil spill occurring in summer. Further coastline of Cook Inlet and Shelikof Strait may be oiled in subsequent weeks following those estimated for the initial 30 days. Tables IV.F-7 and IV.F-8 list conditional probabilities for land segments of Cook Inlet depicted on Map A-3. Spill trajectories analyzed for such a spill do not lead to oiling outside the study area delimited on the map. Oil spill analysis indicates that large surface areas of the upper and lower Cook Inlet, including portions of Kamishak and Kachemak bays, and waters of Shelikof Strait may be oiled as a result of a 120,000-barrel spill as posed in the scenario.

We conclude that enormous numbers (millions) of fisheries resources inhabiting the Cook Inlet and Shelikof Strait may sustain lethal and sublethal effects as a result of a very large oil spill occurring there because of the following:

- many early life-history stages (i.e., eggs and juvenile stages) of fisheries resources (finfishes and shellfishes) inhabit intertidal and subtidal substrates and/or the surface and nearsurface waters of Cook Inlet and Shelikof Strait;
- many such life stages are prolific and plentiful in part or all of the region;
- some adult fisheries-resource species limit their home range to 160 kilometers (or much less) from natal habitat (for example, Pacific herring), while other species are wide ranging and may use large marine ecosystems beyond the Gulf of Alaska;

- acute exposure of early life-history stages and some adults to oiling produces lethal and sublethal effects;
- subtidal substrates oiled by spills (for example, the *Exxon Valdez* oil spill) retain and slowly release biologically damaging polycyclic aromatic hydrocarbons slowly into the environment for more than a decade;
- early life-history stages uptake released polycyclic aromatic hydrocarbons;
- early life-history stages experimentally exposed to polycyclic aromatic hydrocarbons suffered anatomical and physiological aberrations and experienced significantly higher mortality at sea than did control groups;
- some intertidal and demersal spawning species may avoid using oiled substrates for nesting; and
- the scope of the oiling of pelagic, nearshore, and intertidal waters may be extensive.

Millions more, of successive generations, may experience lethal and sublethal effects as a result of indirect impacts lasting more than a decade. Many subpopulations within the study area may experience declines that require multiple generations to recover to formal status.

Some shellfish are at risk of a significant impact from a very large oil spill occurring within Cook Inlet. The magnitude of immediate impacts on bivalve and crustacean subpopulations will vary by species, degree of oiling, and location. Oiling effects on shellfish are described in Section IV.B.1.d (Fisheries Resources) and Section IV.B.1.e (Essential Fish Habitat). Some subpopulations of adult sessile bivalves in nearshore subtidal and intertidal areas may be smothered and die. Some adults may be killed by oiling; however, more individuals may experience only sublethal effects, such as slow growth and depressed fecundity. Adult crustaceans chiefly are found below nearsurface and surface waters where oil slicks occur; however, some adult crustaceans may be killed in nearshore subtidal and intertidal areas. Millions of eggs and juvenile stages of bivalves and crustaceans may be killed or suffer sublethal effects that diminish health, survival, competitive abilities, and fecundity, if exposed to oil in surface and nearsurface waters or intertidal areas. A very large oil spill may cause substantive declines of enough subpopulations of some bivalves in Cook Inlet and Shelikof Strait to cause an overall decline in the abundance of the overall population. Shellfish recruitment rates from subpopulations elsewhere in the study area (for example, those in Prince William Sound) and colonization potential is poorly known for the region, and a conservative estimate of recovery likely would be that they require no less than three generations to recover. In addition to being important fisheries resources, many bivalves and crustaceans are key essential fish habitat and prey to many commercially fished species and protected seabirds and marine mammals.

Fisheries resources believed moderately at risk of significant impacts as a result of a very large oil spill in Cook Inlet include the salmonids. Analysis of launch areas and coastlines potentially impacted show that large areas of surface and near surface waters of pelagic waters and nearshore subtidal and tidal areas may be oiled. The amount of nearshore and intertidal oiling (heavy, moderate, or light) is unclear and likely to be varied. However, millions of eggs and juvenile stages of pink and chum salmon may be oiled and suffer lethal and sublethal effects that include mortality and reduced health, growth, fecundity, competitive ability, and survival. Exposures are not limited to the year of the spill but would extend for more than a decade, because early life-history stages of salmon using oiled substrates as spawning or nursery areas also may be exposed to oil retained in the sediments. However, not all members of a salmon subpopulation spawn each year; many individuals of a subpopulation remain at sea, sometimes not returning for years. Therefore, multiple stocks or subpopulations within Cook Inlet may experience significant declines that, compounded over subpopulations and time among cohorts, may cause a discernible decline in an overall population of pink or chum salmon in the central Gulf of Alaska.

Finfish most vulnerable are species using surface and near surface pelagic waters or nearshore subtidal and intertidal areas as spawning or nursery habitat. Species demonstrating compact home ranges of less than roughly 160 kilometers (100 miles) are made more susceptible. Such finfish species that may suffer significant impacts as a result of a very large oil spill introduced into Cook Inlet are Pacific herring, Pacific sand lance, eulachon, capelin, and walleye pollock. Early life-history stages could be impacted more severely and potentially experience massive mortality and sublethal effects affecting survival, fitness, and fecundity. Moreover, large quantities of plankton, which are important prey to many of these finfishes, also may be removed from the food chain for weeks as a result of a very large oil spill and compound impacts to forage fishes by removing their primary food source (see Sections IV.F.3.e. and IV.B.1.e(3) for more information regarding oil-spill impacts to essential fish habitat, including prey). These finfishes are critical prey to other fisheries resources, seabirds, and marine mammals in the Gulf of Alaska. Therefore, these forage fishes are necessary to the health, structure, and vitality of the Cook Inlet ecosystem and Gulf of Alaska large marine ecosystem.

For example, Pacific herring use essentially the entire mainland shoreline and extensive reefs from Cape Douglas north to Iniskin Bay as spawning and nursery habitat. Pacific herring occurring in the Gulf of Alaska limit their home range to within 160 kilometers (100 miles) of their spawning grounds. The primary spawning grounds in the central Gulf of Alaska, based on recent commercial fisheries established around them, exist in Prince William Sound, Kamishak Bay of Cook Inlet, and the Kodiak Island area (Kruse et al., 2000). The Prince William Sound herring fisheries have been closed since 1998 due to low stock abundance. Abundance was high through the 1980's and into the early 1990's but dropped sharply in association with a virus outbreak (i.e., viral hemorrhagic septicemia virus) in 1993. A very large oil spill impacting early life-history stages of Pacific herring spawned in lower Cook Inlet and Shelikof Strait may cause a significant decline in the overall population of Pacific herring in the central Gulf of Alaska. Additional large losses are expected in the Kodiak Island/Shelikof Strait area, because much of the Shelikof Strait shoreline (Kodiak side) supports herring populations. Losses in this area could exceed 50% of the herring eggs and fry in this area, because this is the most likely place that the oil would go (and remain) from a spill site in Cook Inlet. Moreover, because subpopulations in Prince William Sound and elsewhere in the region already have been in measurable decline since the 1980's, the decline of the Cook Inlet subpopulation may have important ecological consequences to the population dynamics and community composition of the variously scaled and linked ecosystems within the Gulf of Alaska.

IV.F.3.e. Essential Fish Habitat

IV.F.3.e(1) Conclusion

In the very unlikely event that a very large oil spill (120,000 barrels) occurs, effects on beach and intertidal fish habitats could be significant. It could oil between 430 and 568 kilometers of coastline and intertidal habitat within 30 days of the spill and broader areas thereafter. Oil could persist in heavily oiled areas and impact habitat resources (including prey) for more than a decade, which would be three or more generations for some species. It also may render the habitat unavailable to fish for multiple generations, thereby resulting in a significant impact, if the affected habitat is spawning habitat and already limited within waters of the central Gulf of Alaska.

IV.F.3.e(2) Effects of a 120,000-Barrel Blowout

This assumed blowout spill would be about half the size of the 257,000-barrel, 1989 *Exxon Valdez* oil spill in Prince William Sound; therefore, the expected effects would be smaller. A recent survey of remaining North Slope Alaska crude oil from the *Exxon Valdez* spill in Prince William Sound found unexpectedly high levels of oil with little weathering, after more than a decade. The best indicator of fish habitat recovery is the status of resource recovery as classified by the *Exxon Valdez* Oil Spill Trustee Council (2002), which is summarized as follows:

The intertidal communities are considered to be recovering but not fully recovered from the effects of the oil spill, based on the lack of full recovery of some soft-sediment intertidal invertebrates as well as the continued presence of residual oil and based on the role of oil in initiating fucus seaweed population instability. That is, a different species of fucus seaweed took over and does not provide the same quality of habitat in some oiled areas.

Sediments are presently considered still to be in the process of recovering. Four and five years after the spill, surface and subsurface oil mousse persisted in a remarkably unweathered state on five of six boulder beaches. The year of the spill, oil in sediments below the tideline was confined mostly to the uppermost 20-meter water depths (below mean low tide), although elevated levels of hydrocarbon-degrading bacteria associated with elevated hydrocarbons were detected at depths of 40 and 100 meters in Prince William Sound. After 4 years, there was little evidence of *Exxon Valdez* oil and related elevated microbial activity at most index sites except at those associated with sheltered beaches that were heavily oiled in 1989. Those sites are among the few sites at which substantial subsurface oiling is still known to occur. The classification of recovering was based on this information. However, the presence of surface and subsurface oil continues to expose and potentially harm living organisms. Sections IV.B.1.d, IV.B.1.e(3), and IV.F.3.d more thoroughly explain oil-spill effects to fisheries resources or essential fish habitat.

In the pelagic environment where such a blowout would first be introduced into seawater, complex processes influence the life-history characteristics (i.e., fate) of an oil slick. The progression, duration, and result of these transformations are dynamic and unique to the incident (Patin, 1999). However, spilled oil undergoes some general life stages in pelagic habitats that include physical transport, dissolution, emulsification, oxidation and destruction, sedimentation, microbial degradation, and aggregation (for example, lumps and tarballs). Patin (1999) describes these transformations in more detail. Different species whose fish eggs, larvae, and juveniles, and their prey inhabit pelagic habitats. Therefore, they may be exposed to oil undergoing transformation through the listed stages. Acute or chronic exposure of fish eggs, larvae, and juveniles, and their prey to oil may result in lethal and sublethal effects. Sublethal effects may include biological abnormalities and disorders that result in reduced fitness, fecundity, and survival.

Effects of an unlikely, very large blowout spill of 257,000 barrels include oiling of up to 568 kilometers of coastline and adjacent intertidal habitat within 30 days of a winter oil spill. A summer oil spill may contact up to 430 kilometers of coastline and adjacent intertidal habitat within 30 days. Besides impacting a larger area, the winter spill has a greater likelihood of affecting the spawning habitat and spawning survival of fish species that spawn in the spring. Additional areas may be impacted after that projected for 30 days as the spill continues to disperse. Much of upper and lower Cook Inlet and the Shelikof Strait may be impacted by such a spill. The occurrence of a very large blowout may result in significant impacts to some essential fish habitats (chiefly coastal habitats) that may require decades to fully recover.

IV.F.3.f. Endangered and Threatened Species

IV.F.3.f(1) Conclusion

Available information indicates it is unlikely that the species of large cetaceans (blue, sperm, sei, North Pacific right, humpback and fin whales) that occur in areas within or relatively near the proposed Cook Inlet sales area would suffer significant population adverse affects from a very large but low probability blowout spill originating in Cook Inlet. However, individuals or small groups of humpback, fin, and beluga whales, and potentially larger groups of humpback whales, could be exposed, injured, or potentially even killed, in a very large spill resulting from a blowout. These effects could cause short-term changes in local distribution and abundance. Additionally, National Marine Fisheries Service biologists have observed hundreds of humpbacks near the Barren Islands in late May. If a large spill occurred in the Barren Islands area when such large numbers of humpbacks are present and feeding, we cannot rule out the possibility that there could be a population-level effect on this species. Available information suggests that a large spill originating in other areas of the proposed multiple-sale area, but outside of the Barren Islands area, would not have the potential to have a population-level effect on this species. Fin whales are vulnerable to a large spill that entered Shelikof Strait at any time of the year, whereas humpbacks primarily are vulnerable only during the late spring, summer, and late autumn months but are unlikely to be affected during the winter or early spring. There are no data available to the MMS that definitely link a large oil spill with a significant population-level effect on a species of large cetacean. The likelihood of oil-spill effects on cetaceans, even in the unlikely event of a very large spill, is uncertain.

There is the potential for Cook Inlet beluga whales to suffer both direct and indirect adverse effects in the unlikely event of a very large oil spill following a blowout in Cook Inlet during the nonsummer months. However, "Data do not exist which describe any behavioral observations or deleterious effect of" previous spills in the regions on beluga whales or that "accurately predict the effects of an oil spill on beluga whales." (National Marine Fisheries Service, 2000a:45). It is unlikely that the eastern population of Steller sea lions would suffer a significant population-level adverse effect, even in the unlikely event of a very large spill. However, individuals from this population could be adversely affected or killed from such an event.

Information suggests that important Steller sea lion rookeries and haulouts would be relatively likely to be contacted by oil if a low probability blowout occurred in Cook Inlet. In the very unlikely event such a spill occurred in the spring when very young pups are on the rookeries, or possibly if large numbers of the western population sea lions were exposed under certain conditions to high concentrations of fresh oil, the western population of sea lions could suffer significant population-level effects. If prey within Steller sea lion critical habitat was harmed to the extent that prey availability to Steller sea lions was significantly reduced, or if rookeries were oiled sufficiently that individuals (especially pups) were likely to be harmed by the oil, then there would be significant adverse effects on that habitat. In the event of a very large spill resulting from a blowout in Cook Inlet, it is likely that there would be serious, and possibly significant, population-level direct and indirect adverse effects on sea otters from the designated Southwest Alaska population stock.

With respect to potential oil-spill effects, the National Marine Fisheries Service (2003) concluded that:

> *Most sea lions and whales exposed to spilled oil are expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey items, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals may be killed as a result of exposure to freshly spilled oil….the percentage of the stock or population of these animals so affected is expected to be small.*

Available information indicates it is unlikely that the short-tailed albatross, American peregrine falcon, or Aleutian Canada goose would suffer significant adverse affects from a very large but low probability blowout spill originating in Cook Inlet.

The American breeding population of Steller's eiders also likely would suffer serious, possibly significant population-level adverse effects in the unlikely event of a very large spill resulting from a blowout that occurred in the late autumn, winter, or early spring. However, most of the affected eiders are expected to be from the Russian breeding populations. However, uncertainties about the accuracy of this assumption make estimation of potential effects difficult.

Individual American peregrine falcons potentially could suffer some adverse effect from disturbance associated with the Proposed Action or, in the unlikely event of a large oil spill, by catching and eating oiled prey. Such effects are unlikely due to their distribution and relative rarity in the area. Potential adverse effects of any kind are not likely for blue whales, North Pacific right whales, sperm whales, Aleutian Canada geese, and short-tailed albatrosses

IV.F.3.f(2) Effects of a 120,000-Barrel Blowout

IV.F.3.f(2)(a) Introduction

A highly unlikely event that could have high impact, and that could occur following future OCS oil and gas development associated with the proposed lease sales, would be a very large spill. We emphasize that such a spill is not considered a possibility of exploration activities. We emphasize also that available data indicate that such a spill is very unlikely to occur. It is not an expected activity of either exploration or of potential associated future development or production. However, we evaluate the potential impacts from such a spill as a possible worst-case outcome of the Proposed Action because of the high potential impacts that could result from such a spill. If such a spill were to occur, it would occur after development. With respect to endangered and threatened species, under Section 7 of the ESA, consultation would need to be reinitiated prior to such development. Under NEPA, the MMS also would prepare a separate EIS prior to such a development.

It is unlikely that the eastern population of Steller sea lions would suffer a significant population level adverse effect even in the very unlikely event of a very large spill. However individuals from this population could be adversely affected or killed from such an event.

IV.F.3.f(2)(b) Marine Mammals

IV.F.3.f(2)(b)1) General Considerations

While reports of mammals surfacing in oil, or wholly or partly oiled, are abundant (summarized in Geraci, 1988), after most spills, little or no monitoring of resident mammalian species occurs. Thus, while it is clear that exposure to petroleum hydrocarbons can be very harmful in certain circumstances, there are few postspill studies with sufficient details to reach firm conclusions about the effects, especially the long-term effects, of an oil spill on free-ranging populations of marine mammals.

It is well documented that exposure of at least some mammals to petroleum hydrocarbons through surface contact, ingestion, and especially inhalation can be harmful. Surface contact with petroleum hydrocarbons, particularly the low-molecular-weight fractions, can cause temporary or permanent damage of the mucous membranes and eyes (Davis, Schafer, and Bell, 1960) or epidermis (Hansbrough et al., 1985; St. Aubin, 1988; Walsh et al., 1974). Contact with crude oil can damage eyes (Davis, Schafer, and Bell, 1960). Corneal ulcers and abrasions, conjunctivitis, and swollen nictitating membranes were observed in captive ringed seals placed in crude oil-covered water (Geraci and Smith, 1976), and in seals in the Antarctic after an oil spill (Lillie, 1954). Corneal ulcers and scarring were observed in oiled otters brought into oil-spill treatment centers (Wilson et al., 1990) after the *Exxon Valdez* oil spill. Ingestion of petroleum hydrocarbons can lead to subtle and progressive organ damage or to rapid death. Inhalation of volatile hydrocarbon fractions of fresh crude oil can damage the respiratory system (Hansen, 1985; Neff, 1990), cause neurological disorders or liver damage (Geraci and St. Aubin, 1982), have anaesthetic effects (Neff, 1990) and, if accompanied by excessive adrenalin release, cause sudden death (Geraci, 1988). Many of these potential impacts and other more crude impacts [for example, drowning of seal pups encased in oil (Davies, 1949)] and increased mortality have been observed in one or more species of pinnipeds or, more rarely, in cetaceans, following oil spills or in experimental studies (for example, Bourne, 1979; Davies, 1949; Davis and Anderson, 1976; Geraci and Smith, 1976; Gill, Booker, and Soper, 1967; Lillie, 1954; Matkin et al. 1994; Spraker, Lowry, and Frost, 1994; and other references cited in Geraci, 1988 and St. Aubin, 1988), in polar bears (Oritsland et al., 1981), and in other species such as otters (see the following discussion). Many polycyclic aromatic hydrocarbons are teratogenic and embryotoxic in mammals (Khan et al., 1987). Maternal exposure to crude oil during pregnancy may negatively impact the birth weight of pups. The fetuses of rats whose mothers were given repeated small doses of Prudhoe Bay crude oil during pregnancy had significantly lower weights and crown-rump lengths than control rats (Khan et al., 1987). All fetuses of rats exposed to polycyclic 7,12-dimethylbenz(a)anthracene during key periods of pregnancy were stunted and oedematous in the deep portions of the dermis and underlying subcutaneous layers (Currie et al., 1970). Aromatic components of crude oil have been associated with a variety of hemorrhagic abnormalities in humans (Haley, 1977).

After seals were experimentally dosed with crude oil, increased gastrointestinal motility and vocalization and decreased sleep were observed (Geraci and Smith, 1976; Engelhardt, 1985, 1987).

Evidence suggests that mammalian species vary in their vulnerability to short-term damage from surface contact with oil (summarized in Geraci and St. Aubin, 1988) and ingestion. However, while differences in acute vulnerability to oil contamination do exist due to ecological (for example, nearshore versus offshore habitat) and physiological reasons (for example, dependence on fur rather than on blubber for thermal protection), species also vary greatly in the amount of information that has been collected about them and about their potential oil vulnerability. These facts are linked, because the most vulnerable species have received the most focused studies. However, it also is the case that it is more difficult to obtain detailed information on the health, development, reproduction and survival of large cetaceans than on mustelids, such as sea otters, or on pinnipeds, such as sea lions.

There is relatively little information available regarding longer-term impacts of large oil spills on affected mammalian populations. Available reports suggest *Exxon Valdez* oil spill-related chronic impacts on river otters (*Lutra canadensis*) (Bowyer, Testa, and Faro, 1995; Duffy et al., 1993, 1994) and sea otters (for example, Rotterman and Monnett, 1991; Ballachey, Bodkin, and DeGange, 1994; Rotterman and Monnett, 2002).

In 1989 and the fall of 1990, adult female sea otters in oiled parts of Prince William Sound were in relatively poor condition (Rotterman and Monnett, 2002) and had poorer health (Monnett and Rotterman, 1990; Rotterman and Monnett, 2002) than females in eastern Prince William Sound. Rotterman and Monnett (2002) concluded that available information indicated that such differences were likely due to *Exxon Valdez* oil spill-related factors. Post-*Exxon Valdez* oil spill, western Prince William Sound sea otter females tended to have elevated liver enzymes compared to eastern Prince William Sound females, consistent with damage to the liver (Monnett and Rotterman, 1990).

Marine mammals and affected birds also can be affected indirectly after a spill due to oil and cleanup damage to prey resources (for example, see section on potential impacts to sea otters from a very large spill). Additionally, after oil spills, potential causative mechanisms (for example, exposure to petroleum hydrocarbons and lack of prey due to damaged prey resources) might interact. In fish (Rice, 1985) and in birds (Leighton, Butler, and Peakall, 1985) environmental stress, such as fluctuation in food abundance and temperature, may increase the vulnerability to PH exposure. In birds, oil ingestion may contribute significantly to morbidity or mortality even when other factors may be the immediate causative agent (Leighton, Butler, and Peakall, 1985) and increases susceptibility to lethal bacterial disease (Rocke, Yuill, and Hinsdill, 1984). Because oil ingestion can decrease food assimilation of prey eaten (for example, St. Aubin, 1988), the resulting effect on an affected individual bird or mammal would be much like that seen if prey quality or quantity was reduced.

IV.F.3.f(2)(b)2) Threatened, Endangered, and Candidate Whales

Available information indicates it is unlikely that the species of large cetaceans that occur in areas within or relatively near the proposed sales area would be likely to suffer significant population adverse affects from a very large blowout spill originating in Cook Inlet. However, individuals or small groups of a few species of whales could be injured or potentially even killed in a very large spill resulting from a blowout. These effects could cause short-term changes in local distribution and abundance.

This conclusion is based on data collected after the *Exxon Valdez* oil spill and other spills. However, information about environmental impacts on whales is rudimentary and full of speculation and uncertainty. While animals such as sea otters, many birds, and even sea lions can be examined closely, impacts on whales from oil spills (and many other perturbations) are difficult to assess because large numbers of most of the species cannot be easily captured, examined, weighed, sampled, or monitored closely for extended periods of time. Thus, impacts such as the sublethal impacts observed on sea otters (for example, reduced body condition, abnormal health, etc.) (see Rotterman and Monnett, 2002 and references cited therein) after the *Exxon Valdez* oil spill are unlikely to be documented in cetaceans because the data needed to determine whether or not such impacts exist cannot be collected. On the other hand, it may be that ecological and physiological characteristics specific to large cetaceans serve to buffer them from many of those same types of impacts. Unless impacts are large and whales die and are necropsied, most effects must be measurable primarily using tools of observation. Unless baseline data are exceptionally good, determination of an effect is only possible if the effect is dramatic. With whales, even when unusual changes in abundance occur following an event such as the *Exxon Valdez* oil spill (as with the disappearance of relatively large numbers of killer whales from the AB pod in Prince William Sound) (see Dahlheim and Matkin, 1994 and the following discussion), interpretation of the data is uncertain or is often controversial due to the lack of supporting data, such as oiled bodies or observations of individuals in distress (and, in that case, the existence of a viable alternative explanation of the probable mortality). With that caveat, we review existing information on the impacts of large oil spills on whales and other marine mammals, consider the occurrence of the relevant species within areas the Oil-Spill-Risk Analysis indicates could be impacted by oil, and evaluate the probable impacts of a large spill on threatened and endangered whales in the vicinity of Cook Inlet.

IV.F.3.f(2)(b)2)a) Blue, Sperm, Sei, and North Pacific Right Whales

As summarized in Section III.B.4, blue, sperm, and sei whales tend to inhabit offshore areas in the Gulf of Alaska that, based on the Oil-Spill-Risk Analysis and data available from previous spills, are unlikely to be impacted even after a very large spill. Sei whales occasionally have been observed in areas southwest of Shelikof Strait and even in the proposed Cook Inlet Program Area. However, their occurrence in these areas is very rare. Sperm whales also have been observed just southwest of Shelikof Strait and in the Alitak Bay area in the very southern region of Shelikof Strait, but their occurrence in these areas also is extremely rare.

Based on information presented in the affected environment, and consideration of the likely path of a spill originating in Cook Inlet, it also is highly unlikely that a North Pacific right whale would be impacted by such a spill. While right whales are probably the most, or one of the most, vulnerable cetacean species to the impacts of an oil spill in their habitat due to their habit of skim feeding, the Oil-Spill-Risk Analysis model does not take fresh oil into habitat that is known to be inhabited by right whales (for example, see National Marine Fisheries Service, 1984). The conclusion that blue, sperm, sei, and right whales are unlikely to be impacted by a large spill in Cook Inlet also is supported by observations following the *Exxon Valdez* oil spill. These species were not observed in oil; they also were not observed in regions where oil from *Exxon Valdez* oil spill was known to travel.

Thus, available information indicates that even if a major spill occurred due to a large blowout (which is itself an event that we do not expect to occur), the probability that a blue whale or a North Pacific right whale might be impacted by such a spill is essentially negligible because of their distributions and rarity. The probability that a sei or a sperm whale would be impacted by such a spill is exceedingly low, because they are rare in areas that are in the likely path of such a spill.

IV.F.3.f(2)(b)2)b) Humpback Whales, Fin Whales, and Beluga Whales

Endangered Species Act-protected or -candidate cetacean species that are more regular inhabitants of areas within and/or near the proposed Cook Inlet Program Area that have the potential to be impacted by oil spill in Cook Inlet include humpback whales, fin whales, and the Cook Inlet stock of beluga whales. Individual or small groups of humpback whales and fin whales potentially could be adversely affected or even killed due to a very large spill following a blowout. Larger groups of humpbacks could be impacted if a large spill occurred in the Barren Islands during the summer months when humpbacks are feeding there. Cetaceans that inhabit areas that are in the path of a major oil spill can be impacted in several different ways. First, individuals potentially could be directly affected by contact with the oil or its toxic constituents through inhalation of aromatic fractions of unweathered oil (probably the most serious threat to cetaceans), ingestion (of the oil itself or of contaminated prey),fouling of their baleen, and surface contact. Second, they could be indirectly impacted if the quality or quantity of their prey were reduced. Third, individuals could be directly or indirectly affected due to maternal effects (for example, changes in food assimilation during pregnancy, or reduced maternal health) or in utero exposure to toxic components of oil. Fourth, they could be affected by disturbance of spill response and cleanup activities. Although there is evidence for all of the aforementioned types of effects in other types of mammals from experiments and/or postspill studies, there is very little evidence regarding the probability for any of the aforementioned in cetaceans due to limitations discussed above.

Humpback whales occur in areas off of Kodiak Island in the Gulf of Alaska, in the entrances from the Gulf of Alaska to Cook Inlet, in Shelikof Strait, in bays of Kodiak Island, and in lower Cook Inlet in the summer. As noted in the affected environment section, fin whales inhabit bays on the western side of Kodiak Island, parts of Shelikof Strait, and probably bays across the Strait along the Alaska Peninsula (Zwiefelhofer, 2002, pers. commun.) on an essentially year-round basis. Both species feed in these regions, although the largest aggregations of humpbacks are on the Gulf of Alaska side of Kodiak Island. Sighting data suggest that humpback whales tend to enter Shelikof Strait from the north side of Kodiak Island and probably feed in the areas around the Barren Islands and the entrances to Cook Inlet. In their comments to MMS on the draft EIS, the National Marine Fisheries Service stated the following regarding humpback whales:

> While the DEIS…presents an excellent narrative describing this important species of endangered whale, it is also evident that the sale area supports feeding aggregations of humpback whales from one or more stocks. NMFS has received many reports of ‘several hundred’ humpbacks sighted near the Barren Islands by summer fishing charters, and have observed humpbacks on several occasions feeding near the Kenai Peninsula coastline north and east of Elizabeth Island.

Sightings of fin whales suggest they tend to enter from the southern end of Shelikof Strait. However, available sighting data are opportunistic and may not accurately portray typical use. The humpbacks that frequent the Kodiak region may represent a distinct feeding aggregation (see discussion in the affected environment section). Humpback whales also feed in Prince William Sound where they have been studied since the late 1970’s (von Ziegesar, Miller, and Dahlheim, 1994). Oil-Spill-Risk Analysis data indicate that oil from a very large spill in Cook Inlet would travel through Shelikof Strait. Whales are highly mobile, and movement of oil can vary locally depending on tidal and wind conditions. Thus, available data indicate that some fin whales and humpback whales in Shelikof Strait could be in the path of a large spill. Fin whales that were deep in bays at the time oil passes through are unlikely to be oiled. However, oil that hits land anywhere on Kodiak Island or on the opposite shore on the Alaska Peninsula may be remobilized, causing repeated sheening and slicks in the strait and in bays. Such remobilization and redistribution of oil from the *Exxon Valdez* oil spill occurred repeatedly over the course of especially the first year (for example, Spies et al., 1996; Rotterman and Monnett, 2002). An oil spill that originated in portions of the proposed sales area near the Barren Islands could impact individuals, small groups, and potentially large groups of humpback whales and their prey.

As summarized in Section II.B.4, beluga whales inhabit areas of Cook Inlet, including areas within and adjacent to the proposed program area. As discussed extensively in Moore et al. (2000); Rugh, Shelden, and Mahoney (2000); Hobbs, Rugh, and DeMaster (2000); and Laidre et al. (2000), in summer belugas tend to be concentrated in the upper areas of Cook Inlet. Their nonsummer range is less well defined. While seven radio-tagged whales did not tend to venture into areas south of Kalgin Island, varying numbers of beluga whales sometimes are seen in the Kachemak Bay area, including sightings in the spring in the mid-1990's in the Mud Bay area (Monnett, 2002,pers. commun.) and sightings in two recent years at the head of Kachemak Bay (Field, 2002, pers. commun.). Sightings of belugas in many years in the Yakutat Bay region, and much less frequently in Prince William Sound, suggest belugas sometimes leave Cook Inlet in the winter.

Because oil from the *Exxon Valdez* oil spill traveled through humpback whale summer feeding habitat in Prince William Sound, and humpback and fin whale feeding habitat in the Kodiak Island/Shelikof Strait regions, and because resident killer whales (like the beluga, an odontocete) were observed in oil after *Exxon Valdez* oil spill, data from the *Exxon Valdez* oil spill are especially useful for evaluating potential impacts from a spill in Cook Inlet.

After the *Exxon Valdez* oil spill, von Ziegesar, Miller, and Dahlheim (1994) stated that potential impacts to humpback whales from the *Exxon Valdez* oil spill included displacement from normal feeding areas, reduction in prey, or possible physiological impacts resulting in mortality or reproductive failure. In all 3 years of von Zeigesar's study, humpback whales were observed primarily in Knight Island Passage and areas in the southwestern portions of the sound (see Figures 10-6 and 10-7 in von Zeigesar, Miller, and Dalheim1994). von Zeigesar, Miller, and Dalheim (1994) reported that no humpbacks were observed feeding in water with floating oil but were seen in areas that comprised the primary path of the spill. However, most of the still floating oil had exited the sound prior to peak humpback abundance. In addition, oil continued to wash off of beaches due to wave action and oil-spill-cleanup activities. Whales also were exposed to increased noise and other disturbance due to oil-spill cleanup. von Zeigesar, Miller, and Dalheim (1994) report that no humpbacks were observed swimming in oil and no humpback deaths or strandings were reported during 1988-1990 in Prince William Sound. They concluded that the results of their study do not indicate a change in calving rate, seasonal residence time, mortality, or abundance. They concluded also that long-term impacts to the whales or their environment could not have been detected in the short period of their study, and that because of the wide distribution of humpback whales in the North Pacific and unequal surveying effort in their study, the effects, if any, of the *Exxon Valdez* oil spill on humpbacks may never be known.

The impacts on other baleen, as well as toothed, cetaceans after the *Exxon Valdez* oil spill also provides some information about the vulnerability of these whales to oil. While species' vulnerability to oil impacts may vary, information about any cetacean species is useful for assessing potential adverse effects on cetaceans in Cook Inlet and Shelikof Strait if one assumes, based on available literature, that the greatest avenue of impact on these whales is likely to be through inhalation of high toxic aromatic components of fresh crude oil.

Loughlin (1994) reported that 26 gray whales were found in 1989 on Alaska beaches from Kayak Island to King Salmon. Most of the whales were along the outside of the Kodiak Archipelago near Sitkinak and Tugidak Islands. During 1990, 9 gray whales were stranded at Sitkinak Island and 17 were stranded at Tugidak. Thirty-six gray whale carcasses were counted at these islands in 2 years (Loughlin, 1994). Six gray whales were reported between Kayak Island and Sarichef during 1975-1987. Loughlin (1994) concludes that the reason for the greater number of whales found in 1989 is unexplained but may be attributable to the fact that the search after the *Exxon Valdez* oil spill coincided with the northern migration of gray whales and to the greater activity in remote areas after the spill. Data are insufficient to reach any conclusion about the cause of death of these whales. Other dead cetaceans found in 1989 included one fin whale and one minke whale, both in upper Cook Inlet, one minke whale on Montague Island, and four harbor porpoise (two in the Kodiak areas). Samples from three gray whales, two minke whales, and five harbor porpoise were analyzed for hydrocarbon contaminants. Blubber from one gray whale showed a polycyclic aromatic hydrocarbon level of 467 nanograms per gram wet weight, with a polycyclic aromatic hydrocarbon profile consistent with a petrogenic source (Loughlin, 1994). Polycyclic aromatic hydrocarbon levels in the blubber of one of five harbor porpoises examined were similar (446 nanograms per gram wet weight) but Loughlin did not discuss the polycyclic aromatic hydrocarbon profile of this animal. Loughlin (1994), reported that histological examination of all tissues were unremarkable and provided no information about the cause of death of any of the cetaceans.

Loughlin (1994) observed gray whales swimming in oil from the *Exxon Valdez* oil spill in March 1989, but no gross abnormalities were reported. J. Lentfer (as reported in Harvey and Dahlheim, 1994) reported seeing three gray whales at the southwest entrance to Prince William Sound swimming northwest through a moderate amount of oil. Six other whales were observed near the southwest entrance to Prince William Sound. Based on 10 minutes of observation, Lentfer reported that the whales continually swam at the surface and appeared lethargic. Fumes from the oil were apparent in the airplane at 100-200 meters elevation (J. Lentfer, cited in Harvey and Dahlheim, 1994).

Matkin et al (1994) reported that all seven regularly encountered resident killer whale pods inhabited oiled areas of Prince William Sound after the *Exxon Valdez* oil spill. They also reported that killer whales had the potential to contact or consume oil, because they did not avoid oil or avoid surfacing in slicks. Only in the 2 years following the *Exxon Valdez* oil spill did significant numbers (13) of individual whales, primarily reproductive females and juveniles, disappear from AB pod. These authors reported that this mortality was significantly higher than in any other period except when killer whales where being shot by fishers during sablefish fishery interactions. Dahlheim and Matkin (1994:170) concluded that “There is a spatial and temporal correlation between the loss of the 14 whales and the *Exxon Valdez* oil spill, but there is no clear cause-and-effect relationship.” Harvey and Dahlheim (1994) observed 18 killer whales, including 3 calves, and saw the pod surface in a patch of oil. Dahlheim and Matkin (1994) also reported seeing AB pod swim through heavy slicks of oil.

The area along the south side of the Kenai Peninsula also historically may have been inhabited by North Pacific right whales, but there were no definitive sightings of right whales in that area in the 10 years prior to, or following, the *Exxon Valdez* oil spill. Available information indicates that sei, sperm, and blue whales also were not in the path of the *Exxon Valdez* oil. None were reported in oil or are reported from surveys conducted in areas near where oil from *Exxon Valdez* oil spill traveled.

Neither mysticete nor odontocete whales seem to avoid oil, although they can detect it (Geraci, 1990). However, in captivity, bottlenose dolphins avoided an oiled area (Geraci, St. Aubin, and Reisman, 1983). Geraci (1990) reported that fin whales, humpbacks, dolphins and other cetaceans have been observed entering oiled areas and behaving normally. After the *Exxon Valdez* oil spill, Dall’s porpoises were observed 21 times in light sheen, and 7 times in areas with moderate to heavy surface oil (Harvey and Dahlheim, 1994). Of those porpoises for which oiling status could be determined, only one was observed with oil on its skin. Harvey and Dahlheim (1994) report that the the dorsal surface of the porpoise’s body, from the blowhole to the dorsal fin, was covered in oil. They report that this individual appeared stressed because of its labored breathing pattern. Lung problems were common in oiled otters brought into treatment centers after the *Exxon Valdez* oil spill and are frequent in mammals following inhalation of petroleum hydrocarbons.

Large numbers of gray whale carcasses have been discovered previously in other parts of the range (see examples in Loughlin, 1994). Brownell (1971) concluded that reports were incorrect that gray whales and other cetaceans died after the Santa Barbara Channel oil spill.

Geraci (1990) summarized available information about the physiological and toxic impacts of oil on cetaceans (see Table 6-1 in Geraci, 1990). He concluded that although there have been numerous observations of cetaceans in oil after oil spills, there were no certain deleterious impacts. While petroleum can damage mammalian skin, Geraci and St. Aubin (1985) reported little effects with exposures of 75 minutes. Lipid composition was not modified, and epidermal cell proliferation was not significantly reduced. However, as pointed out by Harvey and Dahlheim (1994), the significance of these results is uncertain because of small sample sizes and the uncertainty of their applicability to natural situations. It is not clear why some cetaceans that are observed in oil do not become oiled while at least a few apparently do. It is not clear how long crude oil would remain on a free-ranging cetacean's skin once it was oiled.

Whales also could be impacted by a very large spill due to indirect impacts on their prey. In the section on the potential impacts of a very large spill on lower trophic-level organisms, the author concluded that the effects of a 120,000-barrel spill probably would be similar to the effect of the high-case oil spill that was assessed in the previous Cook Inlet EIS (USDOI, MMS, Alaska OCS Region, 1995:Section IV.B.11.b(4)). The previous EIS concluded that the high-case spill was estimated to have sublethal and lethal effects on up to 5% of the plankton and up to 60% of the intertidal and shallow subtidal marine plants and invertebrates in the sale area. It also concluded that less than 5% of the subtidal benthic populations in the sale area would be affected, that recovery would take up to 2 weeks for plankton, and that recovery of marine plants and invertebrates would take up to 3 years in high-energy habitats and up to 7 years in low-energy habitats.

We refer readers to the sections on the effects of a 120,000-barrel blowout on Fisheries Resources (Section IV.F.3.d) and on Essential Fish Habitat (Section IV.F.3.e) for detailed discussion of the potential adverse effects of a blowout on fish and their habitat.

In summary, available evidence does not suggest significant population impacts would occur to fin whales, humpback whales, North Pacific right whales, sei whales, sperm whales, or blue whales due to a very large oil spill in Cook Inlet. However, for reasons discussed in Section IV.F.3.f(2)(b)1), if individual, small groups or, less likely, large groups of whales were exposed to large amounts of fresh oil, especially through inhalation of highly toxic aromatic fractions, they might be seriously injured or die from such exposure. Although there is very little definitive evidence linking cetacean death or serious injury to oil exposure, disappearances (and probable deaths) of killer whales and the deaths of large number of gray whales both coincided with the *Exxon Valdez* oil spill and with observations of members of both species in oil. However, in these two cases, even if one assumed the disappearances of the killer whales and the high number of gray whale carcasses both were the result of the coinciding oil spill, and one assumed impacts on fin or humpback whales of the same magnitude, it is unlikely that there would be a significant population-level adverse effect on either species in the event of a very large oil spill. Although accurate estimates of their populations are lacking, it is clear that the stocks of both humpback whales and fin whales are not exceedingly small. If the magnitude of the impact on these two species was comparable to the numbers of killer whales disappearing (13) or the number of gray whale carcasses detected (total for 2 years = 36) on beaches, available evidence suggests that local abundance of fin whales in Shelikof Strait could be affected over the short term. Because the humpback whales feeding in the area tend to be congregated in the Albatross Banks area east of Kodiak Island, it is unlikely that significant effects on local abundance would occur on humpback whales in this area. Given available information, we cannot, however, rule out the possibility that there could be a significant effect on humpback whales in the unlikely event that a blowout occurred in the Barren Islands area and resulted in a very large oil spill at the time when large numbers of humpbacks were present in this region. Biologists with the National Marine Fisheries Service have observed "hundreds" of humpback whales (Sease and Fadely, 2001) in the area near the Barren Islands. The observations indicated that the humpbacks are feeding in this area. A National Marine Fisheries Biologist (B. Smith, cited in State of Alaska, Dept. of Natural Resources, 1999) is reported in Cook Inlet Areawide 1999 Oil and Gas Lease Sale documents as stating that about 60-80 humpback whales have been seen near the Barren Islands but none north of Kachemak Bay. As noted in Section III.B.4 on the affected environment, the humpbacks that feed in Kodiak region may be a distinct feeding aggregation. In the event of a very large oil spill in this region when the whales were present, large numbers of this species of this endangered whale could be adversely affected, and some fraction of affected individuals could possibly be killed.

There is the potential for Cook Inlet beluga whales to suffer both direct and indirect adverse effects in the unlikely event of a very large oil spill following a blowout in Cook Inlet. Belugas are mammals, and all of the previously discussed risks form exposure to large amounts of fresh crude oil discussed in Section IV.F.3.f(2)(b)1) are relevant. The greatest direct risk to belugas probably is from inhalation of large concentrations of volatile fractions of crude oil in the event that an individual or pod was in the vicinity of a very large spill or downstream and in the path of the slick resulting from the spill. If such a spill occurred in the summer, when Cook Inlet belugas are concentrated in the upper inlet, it is unlikely that significant adverse effects would occur. A spill that occurred after belugas dispersed from summer feeding areas would be more likely to have a significant impact than if the spill occurred in the summer. Based on the large volume of oil that we are analyzing, based on the known toxicity of exposure to large concentrations of toxic fractions of crude oil to other mammals, and, to be conservative in our analyses, based on the arguable assumption that there may have been a lethal effect of the *Exxon Valdez* oil spill on killer whales (Dahlheim and Matkin, 1994), it is possible, given coincidence of the belugas and large amounts of fresh crude oil, that there could be a significant effect on Cook Inlet beluga whales in the event of a very large oil spill resulting from a blowout. The Oil-Spill-Risk Analysis model indicates that if such a blowout occurred, oil likely would travel to areas known to be occupied by belugas, including Tuxedni Bay and nearby regions. That said, the National Marine Fisheries Service (2000:45) has stated that “Data do not exist which describe any behavioral observations or deleterious effect of” previous spills in the regions on beluga whales or that “accurately predict the effects of an oil spill on beluga whales.”

Multiple small oil spills, large oil spills, and one very large oil spill have occurred in areas known to be within the range of the Cook Inlet beluga population stock. In July of 1987, approximately 1,350-3,800 barrels of crude oil were discharged into Cook Inlet from the tanker *Glacier Bay*, which struck a rock near Nikiski. Beluga whales commonly are sighted in the area where the tanker grounded (National Marine Fisheries Service, 2000). There are no data that suggest beluga whales suffered adverse effects from this spill. In early spring 1989, oil from the *Exxon Valdez* oil spill exited Prince William Sound, traveled into the Gulf of Alaska, into Cook Inlet, and then down Shelikof Strait. However, again there is no evidence of adverse impacts of any kind on beluga whales. This spill occurred before beluga whales should have been aggregated in the northern parts of Cook Inlet. However, by the time *Exxon Valdez* oil reached Cook Inlet, it had weathered and a significant portion of the volatile hydrocarbons had evaporated, thus reducing the concentrations of such substances to which any Cook Inlet resident fauna would have been exposed.

IV.F.3.f(2)(b)3) Sea Lions

As summarized in the following, based on available information, it is uncertain whether Steller sea lions would suffer significant acute impacts form a very large oil spill in Cook Inlet. However, because in the unlikely event of a very large oil spill there is a relatively high probability that important western sea lion population stock terrestrial and marine critical habitats would be contacted by oil, there could be significant impacts on this stock. There have been no long-term studies of oil spills on sea lion health. Impacts likely would depend on their exposure level through inhalation, exposure of mucous membranes to oil, and whether pups became oiled due to transfer of oil from their mothers. Effects on their prey are discussed in the sections on impacts of a very large spill on critical habitat, on fisheries, and on essential fish habitat.

The area of the southern Kenai Peninsula, the Barren Islands, lower Cook Inlet, and the southern Alaska Peninsula across from Kodiak Island all received substantial amounts of oil from the *Exxon Valdez* oil spill in 1989. That spill, and the *Glacier Bay* spill in Cook Inlet in 1987, both provide insight into the likely impacts of a very large spill on Steller sea lions. The *Glacier Bay* spill originated in Cook Inlet. Thus, the behavior and impacts of that spill are directly relevant to evaluating locations and types of impact for a very large spill in Cook Inlet. The *Exxon Valdez* oil spill was arguably the best studied spill in history. Oil from this spill entered Cook Inlet and traversed areas our Oil-Spill-Risk Analysis model indicates also likely would be affected by a very large spill.

Sea lion haulouts were directly in the path of that spill, and the impacts on sea lions were studied. After the *Exxon Valdez* oil spill, Calkins et al. (1994) undertook studies to determine if the *Exxon Valdez* oil spill had population-level impacts or impacts on the health of individuals. However, no Steller sea lion rookeries were in Prince William Sound. One, at Seal Rocks, is at the entrance to the sound. Oil from the *Exxon Valdez* spill took about 3-4 days to reach this rookery (see Morris and Loughlin, 1994:Figure 1-8). Three rookeries near the proposed Cook Inlet Program Area—Outer island, Sugarloaf Island (in the Barren Islands), and Marmot Island in the Kodiak Island area—were in the area generally impacted by the *Exxon Valdez* oil spill. Approximately 25 other haulout sites in the Kodiak Island and Alaska Peninsula region were in the path of oil from the *Exxon Valdez* spill (Calkins et al., 1994).

It is unclear exactly how many sea lions were in the path of the *Exxon Valdez* oil spill, because estimates are based on animals hauled out on rookeries and haulouts. Animals at sea are not known (Calkins et al., 1989). Counts generally are lower in winter than in the summer.

Immediately after the *Exxon Valdez* oil spill on March 26, 2989, three to four Steller sea lions were observed on a buoy in the midst of an oil slick (C. Monnett, cited as personal communication in Zimmerman, Gorbics, and Lowry, 1994). L. Rotterman is cited in Zimmerman, Gorbics, and Lowry (1994) as observing approximately 90 sea lions in or near the slick, some in very thick oil. National Marine Fisheries Service personnel conducted helicopter surveys in Prince William Sound beginning on March 26, 1989, and conducted photographic surveys five times at major rookeries and haulouts—the Needle, Point Elrington, Wooded Islands, and Seal Rocks. Point Elrington and the Needle eventually were oiled. However, the number of animals on these sites did not decrease relative to numbers on oiled sites. Approximately 5-10% of the animals present at oiled sites appeared to be oiled, and none appeared to be debilitated (Zimmerman, Gorbics, and Lowry, 1994).

Calkins et al. (1994) reported that:

> During observations of sea lions near or in oil following the *Exxon Valdez* oil spill,…oil did not persist on sea lions as it did on harbor seals….Oil did not persist on the rookeries and haulout sites either, probably due to their steep slopes and high surf activity. However, some oil fouling was noted on Seal Rocks and Sugarloaf Island in April 1989. Insignificant amounts of oil were seen at each site during pup counts in late June 1989, but none were seen in 1990.

Premature pupping rates were higher at Cape St. Elias, a site closer to the spill (but not in the spill path) in the spring following *Exxon Valdez* oil spill than at Chirikof Island (Calkins et al., 1994), but numbers of premature pups at both sites were small (11 and 1, respectively); Calkins et al. (1994) concluded that an oil-spill effect could not be based on those data alone. Sixteen Steller sea lions were collected for study. Twelve Steller sea lions were found dead during response activities after *Exxon Valdez* oil spill (Zimmerman, Gorbics, and Lowry, 1994). However, studies indicated that some sea lions were exposed to oil and were metabolizing and excreting metabolites of aromatic hydrocarbons into their bile. No lesions that could be linked to hydrocarbon exposure were detected in necropsied Steller sea lions.

Calkins et al. (1994) concluded that none of the data presented and analyzed provided conclusive evidence of an effect from the *Exxon Valdez* oil spill on Steller sea lions. The ongoing decline continued through the period of the *Exxon Valdez* oil spill, but the rate of decline was as predicted by regression models.

The *Exxon Valdez* oil spill arguably was not a good model for evaluating the worst potential impacts of a very large spill in Cook Inlet on sea lion pups, because, as previously noted, there were no rookeries in Prince William Sound. The spill occurred in late March, but pupping takes place from late May to early July. Because of these two facts, no young sea lion pups were exposed to fresh oil from the *Exxon Valdez* spill as they could be from a very large spill in Cook Inlet. Unlike adults, which rely on subcutaneous fat for insulation (Kooyman, Gentry, and McAllister, 1976), young sea lion pups remain out of the water and depend on their pelage for warmth (Hoover, 1988). Oiling of a pup's pelage could adversely impact its thermoregulation. Sea lion pups are born on land and remain on land for some time before venturing out to sea. Thus, neonates are unlikely to become oiled by a marine spill, unless transfer of oil would occur from mother to offspring. As noted above, at least under some conditions, oil does not appear to persist on sea lion adults. Birth tends to take place at sites away from territorial males and above high water (Gentry, 1970; Hoover, 1988). Thus, it is unlikely that the resting-place of young pups would be oiled. As noted, oil did not persist on rookeries. However, after the 1970 oiling of large portions of the eastern shore of the Kodiak Archipelago, probably after the release of "slops" and ballast waters at sea, commercial hunters reported oiled sea lions and two dead oiled sea lions were found (Federal Water Pollution Control Administration, 1970).

IV.F.3.f(2)(b)4) Steller Sea Lion Critical Habitat

Critical habitat for Steller sea lions consists of rookeries, that are used for breeding and pup rearing, haulouts, and marine foraging areas (for example, Shelikof Strait) and aquatic areas. As previously noted, oil from the *Exxon Valdez* spill did not persist on Steller sea lion rookeries or haulouts. Based on that information, we would not expect a significant impact of a major spill on the terrestrial component of sea lion critical habitat. However, it is not clear whether rookeries vary in their tendency to retain oil. If oil remained on rookeries and was transferred to pups, or caused reduced health of adults or pups, there could be a significant adverse effect of the blowout on that critical habitat.

The National Marine Fisheries Service (2001b:97) stated: "Prey resources are not only the primary feature of Steller sea lion critical habitat, but they also appear to control the maximum size of the Steller sea lion population."

Thus, the primary consideration for evaluating impacts of a very large oil spill on sea lion critical habitat is the impact such a spill would have on sea lion prey. Effects of a very large oil spill on sea lion prey species, including prey in the Shelikof Strait special foraging are discussed in the sections on impacts of a very large spill on fisheries, and on essential fish habitat. If oil reduced prey species sufficiently to reduce the amount of prey available to Steller sea lions, there would be a significant adverse effect on that critical habitat.

IV.F.3.f(2)(b)5 Sea Otters

A large or very large oil spill in Cook Inlet could kill large numbers of sea otters from the southwest Alaska stock of sea otters in areas of Cook Inlet, northwestern Kodiak Island, and the southern side of the Alaska Peninsula. Depending on exactly where spilled oil traveled and where sea otters of different age and sex categories were relative to the oil plume, numbers killed or harmed could range from tens to thousands. Estimates of numbers of otters that likely would be killed are problematic, because recent survey data for the western Cook Inlet region were not provided to MMS in a timeframe to permit detailed analysis, no offshore data are available for the Shelikof Strait region or parts of the coastline of the south Alaska Peninsula, distributions of otters change significantly seasonally and over time, and available data indicate a significant decline could be occurring within the range of the designated Southwest Alaska stock due to undetermined causes. Thus, there is great uncertainty as to what the distribution and abundance of sea otters in regions that could be affected would be in 5, 10, 20, or 30 years, when a hypothetical spill could occur. However, data available from experimental studies and from postspill studies demonstrate that sea otters are very vulnerable to the impacts of oil spills. Such data also indicate the fate of sea otters postspill is very dependent on exactly which areas oil impacts and where the otters are at the time. Even after the *Exxon Valdez* oil spill, unoiled "refuges" existed in the main oiled area of the western Sound, and more than a thousand otters survived in the spill zone. Data from past spills indicate that tens to low thousands of otters could die as the result of a very large spill, depending on the previously discussed factors. Additional losses to sea otter populations could occur due to chronic impacts, such as those observed after the *Exxon Valdez* spill.

Otters are very vulnerable to marine oil spills. In the Shetland Islands, an estimated 15-50% of the local population of European otters (*Lutra lutra*) was killed by a fuel oil spill, probably due to oil ingestion (Baker et al., 1981). As noted previously, sea otters (*Enhydra lutris*) probably are the mammalian species most vulnerable to the acute impacts of marine oil spills (summarized in Geraci, 1988b). Air trapped in their pelage provides warmth and buoyancy (Kenyon, 1969; Morrison, Rosenmann, and Estes, 1974; Tarasoff, 1974). Oiling of their pelage increases its thermal conductance; this, coupled with the otter's high metabolic requirements and cold temperatures of the water in their habitat, quickly can lead to hypothermia, even with a relatively small amount of oil contamination. The buoyancy of their pelage probably is decreased by oiling, increasing energy requirements (Siniff et al., 1982). They respond to fouling by grooming, resulting in oil ingestion (Costa and Kooyman, 1982; Siniff et al., 1982). They prey on macroinvertebrates, some of which uptake and accumulate hydrocarbon contaminants from water and sediments (Capuzzo, 1987; Neff and Anderson, 1981). They often congregate in large groups (Ralls and Siniff, 1990) and spend a considerable amount of time floating at the water's surface (Cimberg and Costa, 1985). They inhabit primarily coastal areas, including oil-transportation routes—regions prone to spills (National Research Council, 1985).

The *Exxon Valdez* oil spill on 24 March 1989, resulted in the release of at least 39,000 metric tons of Prudhoe Bay crude oil into Prince William Sound, Alaska and the Gulf of Alaska, an area inhabited by thousands of sea otters and other mammals. After the *Exxon Valdez* oil spill, the extreme vulnerability of the sea otter to a large spill was confirmed. An estimated 4,600 (Garrott, Eberhardt, and Burn, 1993) and 3,905 (95% confidence interval = 1,904-11,157) (DeGange, Doroff, and Monson. 1994) sea otters were killed in the entire spill area with an estimated 2,650 (Garrott, Eberhardt, and Burn, 1993) being killed in Prince William Sound alone. Oiled sea otters captured soon after the spill had medical problems including anemia, dehydration, elevated liver enzymes, elevated BUN levels, low plasma glucose levels (Williams and Wilson, 1990), disorientation, gastrointestinal distress, seizures, hypothermia, hypoglycemia, stillbirths, diarrhea, hemorrhagic enteritis, subcutaneous and bulus emphysema, hemorrhagic necrotizing sinusitis, corneal ulcers, and corneal scarring (Wilson et al., 1990). A high rate of pup mortality, miscarriages and stillbirths were observed in *Exxon Valdez* oil spill-area females brought into treatment centers after the spill. Pups were unable to nurse and became hypothermic due to their mothers' inability to keep their fur properly groomed (Wilson et al., 1990). There are no published data adequate to evaluate the survival of pups born in 1989 to females surviving in the spill area. Contact with crude oil can damage eyes (Davis, Schafer, and Bell, 1960). Corneal ulcers and abrasions, conjunctivitis, and swollen nicititating membranes were observed in captive ringed seals placed in crude oil-covered water (Geraci and Smith, 1976) and in seals in the Antarctic after an oil spill (Lillie, 1954). Corneal ulcers and scarring were observed in oiled otters brought into oil-treatment centers after the *Exxon Valdez* spill (Wilson et al., 1990). Massive harm to resident sea otters shortly after a large spill was confirmed.

Based on evaluation of data of the numbers and ages of sea otter carcasses found on selected beaches in Prince William Sound and on evaluation of survey data, Johnson and Garshelis (1995:924) concluded that pup and adult mortality around the Green Island area over the winter of 1990-1991 was low and that "…1-2 years after the spill, oil from *Exxon Valdez* oil spill having little effect on sea otter populations…." However, these authors acknowledged they had no direct information on post-weaning survival. Rotterman and Monnett (1991) concluded that post-weaning survival of pups born more than a year after the *Exxon Valdez* oil spill was abnormally high in oiled areas. Based on estimated ages of carcasses found on beaches, Ballachey, Bodkin, and DeGange (1994) concluded that survival of prime-aged sea otters was abnormally high in oiled areas for 1 or more years following the spill (but see Johnson and Garshelis, 1995). Other chronic impacts reported for sea otters include relatively poor body condition of adult females (Rotterman and Monnett, 2002) and increased levels of liver enzymes in adults consistent with liver damage (Monnett and Rotterman, 1990). Reports suggest *Exxon Valdez* oil spill-related chronic impacts on river otters (*Lutra canadensis*) (Bowyer, Testa, and Faro, 1995; Duffy et al. 1993, 1994).

Sea otters were not only damaged directly by oil from the *Exxon Valdez* spill; their habitat was damaged by oil and postspill-cleanup activities. There is ample direct evidence from studies conducted over a broad area that, in the spill zone, there was widespread and serious oil- and cleanup-related damage (including decreased survival, abundance, and growth rates) to important sea otter prey species and their habitat (for example, Highsmith et al., 1996; Houghton et al., 1991; Lees, Houghton, and Driskell, 1993, 1996; Stekoll et al., 1996) resulting in decreased prey biomass available for consumption. Affected species included blue mussels (Driskell et al., 1996; Lees, Houghton, and Driskell, 1996); Littleneck clams (Houghton et al., 1996; Lees, Houghton, and Driskell, 1993); helmet crabs and a sea star (*Dermasterias imbricata*) (Dean et al., 1996); limpets (*Tectura persona*) (Highsmith et al., 1996); and snails (*Nucella lamellosa*) (Ebert and Lees, 1996). At areas throughout the entire *Exxon Valdez* oil spill region, damage to sea otter prey and their habitat was documented until at least the summer of 1991 (Highsmith et al. 1996; Houghton et al., 1996; USDOC, National Oceanic and Atmospheric Administration, 1993; Stekoll et al., 1996). In some locations, mussel mortality remained high through 1991 (Lees, Houghton, and Driskell, 1993). However, there are no published data collected over a broad enough area to adequately draw conclusions regarding sea otter foraging success in the spill zone in 1990.

Johnson and Garshelis (1995) concluded that prey contamination would not be widespread enough to affect the resident sea otter population. However, *Exxon Valdez* oil-spill-derived polycyclic aromatic hydrocarbons were abundant (for example, USDOC, National Oceanic and Atmospheric Administration, 1993; Sharp, Cody, and Turner 1996), toxic (Spies et al. 1996; Wolfe et al. 1996), bioavailable to, and taken up by, some species of sea otter prey (for example, Babcock et al. 1996; Shigenaka and Henry 1993) at least through the autumn of 1990. Blue mussels (*Mytilus trossulus*), a critical food item for sea otter weanlings in Prince William Sound (Garshelis 1983; Van Blaricom 1987; Johnson and Garshelis 1995) and for females with dependent pups (Riedman and Estes 1990), took up and accumulated toxic pH from contaminated sediments and/or water (Babcock et al. 1996; Harris et al. 1996). Polycyclic aromatic hydrocarbons from *Exxon Valdez* oil were found in mussels at all locations sampled postspill in Prince William Sound in spring 1989 within the path of the spill (up to a total polycyclic aromatic hydrocarbon concentration of 234,000 $\pm$ 32,4000 nanograms per gram at Green Island). Throughout the spill zone, where mussel beds were in association with obviously oiled beaches, high levels of oil contamination of mussels were documented at least until 1993, and oil in sediments continued to pollute nearby water and provide a source for oil uptake by marine organisms, especially mussels (Babcock et al. 1996; Harris et al. 1996). Some samples of blue mussels, butter clams, and Pacific littleneck clams collected during studies in 1989 and 1990 of subsistence-food contamination from oiled areas within southwestern Prince William Sound had total polycyclic aromatic hydrocarbon levels considered moderately or highly contaminated for human consumption (Brown et al. 1996).

Maternal exposure to crude oil or its derivatives could have impacted pups, because it resulted in indirect pup exposure (for example, during pregnancy or nursing) and/or because it caused decreased maternal health, condition, or both. Many polycyclic aromatic hydrocarbons have been demonstrated to be teratogenic and embryotoxic in mammals (for example, Bui, Tran, and West 1986; Currie et al., 1970; Khan et al. 1987) to cause decreased maternal body-weight gain and to result in decreased fetal weight and length (Khan et al. 1987). Repeated exposure to low levels of Prudhoe Bay crude oil has additive adverse effects on fetuses (Khan et al. 1987). All fetuses of rats exposed to polycyclic 7,12-dimethylbenz(a)anthracene during key periods of pregnancy were stunted and oedematous in the deep portions of the dermis and underlying subcutaneous layers (Currie et al., 1970). Aromatic components of crude oil have been associated with a variety of hemorrhagic abnormalities in humans (Haley, 1977). Direct oiling could have affected the growth, dependency periods, and survival of the otters studied here by reducing the insulatory benefits of their fur, requiring increased heat production and feeding rates (Costa and Kooyman, 1981). In mammals, ingestion of petroleum hydrocarbons has been shown to affect food absorption, digestion, and motility; to be associated with increased activity (St. Aubin, 1988); cause or contribute to death (Baker et al., 1981; Duguy and Babin, 1975); and be associated with liver damage (Duguy and Babin, 1975; Caldwell and Caldwell, 1982, cited in Geraci, 1990).

A recent study of captive mink suggested that sea otter reproductive success could be impacted by oil ingestion. Mazet et al. (2001) compared the reproductive success (measured as number of pups/litter) of female ranch-reared mink fed rations containing either 500 parts per million of Alaska North Slope crude oil (n = 24), 500 parts per million Bunker C fuel oil (n = 24), or control rations (n = 15) for 60 days until breeding. Other groups of females were placed in a slick of either Alaska crude oil (n = 24) or Bunker C fuel oil (n = 24) on seawater, or in seawater alone (n = 10) 60 days prior to breeding. Females were allowed to move about freely for 1 minute in the solution which consisted of 500 milliliters oil to 4 liters seawater, resulting in a slick of approximately 1.5 centimeter in depth. There was no adverse impact of dermal exposure to either crude oil or Bunker C oil on the number of kits/female. However, females exposed to both crude oil and Bunker C through their food produced significantly lower numbers of kits than did controls (mean number of live-born kits/female = 2.3, 0.7, and 5.3 respectively), a reduction of about 57% and 87% related to crude oil and Bunker C fuel oil, respectively. Fewer female mink fed rations containing 500 parts per million Bunker C fuel oil whelped than did the other females.

The extent to which reported chronic *Exxon Valdez* oil-spill-related damages to sea otters resulted from exposure to oil, lack of suitable prey, or both is unclear (Rotterman and Monnett, 2002). Sea otters are too mobile, and there were too many potential avenues for exposure over a long timeframe, to adequately assess oil exposure of individuals (Rotterman and Monnett, 2002). Potential causative mechanisms of damage also interact. In fish (Rice, 1985) and in birds (Leighton, Butler, and Peakall, 1985), environmental stress such as fluctuation in food abundance and temperature may increase vulnerability to petroleum hydrocarbon exposure. In birds, oil ingestion may contribute significantly to morbidity or mortality, even when other factors may be the immediate causative agent (Leighton, Butler, and Peakall, 1985), and increases susceptibility to lethal bacterial disease (Rocke, Yuill, and Hinsdill, 1984). Because oil ingestion can decrease food assimilation of prey eaten (for example, St. Aubin, 1988), the resulting effect on the individual sea otter would be much like that seen if prey quality or quantity was reduced.

IV.F.3.f(2)(c) Threatened, Endangered, and Delisted Birds

Because the Aleutian Canada goose, short-tailed albatross, and American peregrine falcon are rarely in coastal habitats near enough to or in areas “downstream” of the proposed sales area that they are likely to encounter oil spilled in Cook Inlet, it is highly unlikely that they would suffer significant population-level adverse effects, even in the highly unlikely event of a very large oil spill following a blowout (see Section

III.B.4 for discussion of distributions). The Oil-Spill-Risk Analysis model indicates that it is highly unlikely that a very large spill from a blowout would reach the Semedi Islands, the closest breeding islands for the Aleutian Canada goose. While members of this subspecies occasionally are observed as close to the proposed sales area as Kalsin Bay on Kodiak Island, in the biological opinion for Cook Inlet Sale 149, the USDOI, Fish and Wildlife Service (1995a) wrote that: “This subspecies is not known to rest on salt water during migration.”

The American breeding population of the Steller’s eider, however, could suffer serious adverse effects in the unlikely event of a very large oil spill that originated within the proposed sales area and that occurred during the late autumn, winter, or early spring. It is possible that a significant population-level adverse effect would occur.

Birds, especially birds that spend much of their time on the water, are especially vulnerable to oil spills. Steller’s eiders are sea ducks that spend most of their time during the winter in marine waters. This heightens their vulnerability to oil spills (King and Sanger, 1979).

In the unlikely event of such a very large spill, large numbers of Steller’s eiders that overwinter in Cook Inlet and Shelikof Strait could suffer adverse impacts from direct contact with the spilled oil, reduction of prey, ingestion of contaminated prey, and response and cleanup-related disturbance. Steller’s eiders could have their feathers contaminated with oil and/or could ingest oil and die. Impacts on oiled marine birds have many parallels with effects described previously for sea otters. Studies have demonstrated that direct contact with very small amounts of oil can be fatal to marine birds (Nero and Assocs., 1987) due primarily to feather matting and resultant hypothermia following the loss of insulation from their feathers (Erasmus, et al., 1981). Feather oiling also can negatively affect the ability of the birds to fly or swim, and can negatively impact buoyancy, inhibiting the bird’s ability to sleep or rest on the water (Hawkes, 1961). Oiled birds often preen themselves and may ingest oil in the process. Oil ingestion in birds has been linked to lipid pneumonia and liver and kidney dysfunction (Hartung and Hunt, 1966).

Affected birds also can be affected indirectly after a spill due to oil and cleanup-related damage to prey resources (for example, see section on potential impacts to sea otters from a very large spill). Disturbance during cleanup has the ability to displace birds from important resting and foraging areas. Additionally, causative mechanisms (for example, exposure to petroleum hydrocarbons and lack of prey due to damaged prey resources) might interact. In fish (Rice, 1985) and in birds (Leighton, Butler, and Peakall, 1985), environmental stress such as fluctuation in food abundance and temperature may increase the vulnerability to petroleum hydrocarbon exposure. Leighton, Butler, and Peakall (1985) reported that oil ingestion by birds may contribute significantly to morbidity or mortality even when other factors may be the immediate causative agent. Rocke, Yuill, and Hinsdill (1984) reported that oil ingestion by birds increased susceptibility to lethal bacterial disease. Because oil ingestion can decrease food assimilation of prey eaten (for example, St. Aubin, 1988), the resulting effect on an affected individual bird or mammal would be much like that seen if prey quality or quantity was reduced. Oil ingestion potentially could have adverse effects reproductive physiology (Ainley et al., 1981; Holmes, 1984). Steller's eiders could suffer all of the aforementioned adverse effects following a very large oil spill in Cook Inlet. Ingestion of oil commonly has been reported to be associated with depression of the growth rate of young birds (Leighton, Butler, and Peakall, 1985 and references cited therein). In captive and free-ranging birds, a single small dose of oil slowed growth for 1-3 week periods (Miller, Peakall, and Kinker, 1978; Butler and Lukasiewicz, 1979; Peakall et al., 1980, 1982).

Important Steller’s habitat in regions within, near, and downstream of the proposed sales area include shallow, nearshore regions of eastern Cook Inlet between Deep Creek and Bluff Point, near the Homer Spit; near Seldovia; Oil Bay, Iniskin Bay, Iliamna Bay, South Head to Chenik Head (on the western side of Cook Inlet) (Agler et al., 1995); Sitkinak Strait; the passage between Tugidak and Sitkinak Islands; Chiniak Bay; in the immediate vicinity of Kodiak, Akhiok, and Narrow Cape in the Kodiak Archipelago (Larned and Zwiefelhofer, 2001). Although it is difficult to predict losses from a hypothetical blowout that could originate at different assumed locations at different times of years, and under differing wind and tidal conditions, evaluation of all scenarios suggest that Steller’s eiders wintering on the western side of Cook Inlet probably are the most vulnerable to a blowout in Cook Inlet. Based on small boat surveys conducted in 1994, Agler et al. (1995) provided winter and summer abundance estimates of 1,011 and 100, respectively, for Steller’s eiders in lower Cook Inlet. However, while data on densities from these authors’ winter surveys indicate pockets of Steller's eiders during the winter in western Cook Inlet, data are not sufficient to typify winter or summer abundance in Cook Inlet. Based on the Oil-Spill-Risk Analysis, there also is a measurable but relatively small probability (for example up to an 8% chance for Deep Creek) that Steller's eiders on the eastern coast of Cook Inlet would be contacted by oil from a very large spill in the winter. In the event of a real spill, depending on the location of the blowout, wind conditions could cause it to be more likely that oil would travel to the eastern coast, or to other locations. During opportunistic overflights, Larned (2002, pers. commun.; see discussion in Section II.B.4) observed up to 2,370 Steller's eiders in the area between Deep Creek and Bluff Point, of which, about 71 (3% of 2,370) would be expected to be from the American breeding population. Based on the Oil-Spill-Risk Analysis, there is up to a 37% chance that oil spilled in Cook Inlet during the winter (Table A.2-21) would contact outer Kachemak Bay within 30 days. In 2002, (the year with the highest estimated numbers), Petrula and Rosenberg (2002:Table 3) estimated up to about 1,364 Steller's eiders distributed among different offshore strata and counted 85 Steller's eiders in shoreline strata in Kachemak Bay. Although these data are preliminary and final estimates are not available, they indicate that roughly 1,500 or more Steller's eiders could be risk in Kachemak Bay. Based on Fish and Wildlife Service assumptions about relative flock composition, of these Steller's eiders in Kachemak Bay, about 45 would be expected to be from the American breeding population. It is unclear whether birds move from Kachemak Bay to the eastern side of Cook Inlet, but it is possible many of these are the same birds counted in some years by Larned during his overflights. Most of the Steller's eiders that overwinter in the Kodiak Archipelago probably are relatively unlikely to suffer serious adverse effects in the event of a very large oil spill, because they tend to inhabit bays on the west side of the archipelago or in the Trinity Islands area. Winter conditional probabilities from the Oil-Spill-Risk Analysis indicate these locations are very unlikely to be contacted in the event of an oil spill. Larned and Zwiefelhofer (2001) estimated that there were 5,341 Steller's eiders in the Kodiak Archipelago in 2001.

IV.F.3.g. Marine and Coastal Birds

IV.F.3.g(1) Conclusion

Recovery of marine and coastal birds affected by a very unlikely 120,000-barrel oil spill from a blowout could require two to five generations. This level of mortality would constitute a significant impact.

IV.F.3.g(2) Effects of a 120,000-Barrel Blowout

This analysis assumes that a 120,000-barrel oil spill from a blowout occurs in Cook Inlet in LA1 during the summer or winter (Figure IV.A-1). The effect of oil on marine and coastal birds is discussed in Section IV.B.1.g. An oil spill of this magnitude would result in the direct mortality of tens of thousands to possibly as many as 100,000 marine and coastal birds, depending on the time of year and movement of the spill. The effects likely would be worse during the summer months because of the larger number of birds that occur in the area compared to winter and the presence of nesting birds. Assuming the spill swept through a coastal area when and where aggregations of rafting seabirds near Chisik-Duck Island (Tuxedni Bay) were congregating prior to breeding in the spring or during the fall, several thousand murres and other seabird species would be expected to be killed. Assuming the oil spill contacted outer Kachemak or Kamishak bays, several thousand to perhaps as many as 100,000• sea ducks, shorebirds, and local seabirds would be expected to be directly lost to the spill.

Assuming the 120,000-barrel oil spill contacted the coastline and important intertidal habitats of sea ducks and shorebirds in lower Cook Inlet, contamination of intertidal prey organisms of sea ducks and shorebirds, such as intertidal mussels, would be expected to occur. This contamination would be expected to affect productivity of local sea ducks that depend on these food sources through the birds' ingesting petroleum hydrocarbons on and within the mussels or other invertebrate food sources oiled by the spill. This contamination of habitat and resulting effect would be expected to last for more than 1 year to a number of years after the spill.

In the event of a large oil spill contacting and extensively oiling coastal habitats with concentrations of nesting birds, the presence of several thousand humans, hundreds of boats, and several aircraft operating in the area involved in cleanup activities would be expected to cause displacement of nesting birds in the oiled areas and contribute to reduced reproductive success of the birds. This effect would be expected to persist during cleanup operations (perhaps 1 or 2 seasons) and affect birds within about 1 mile of the activity.

Overall, the impacts on marine and coastal birds from a 120,000-barrel oil spill could involve the loss of tens of thousands to possibly as many as 100,000 birds, depending on the timing (summer versus winter) and movement of the spill in relation to bird abundance and distribution. Depending on the number of birds involved, recovery could require two to five or more generations (for the purposes of this analysis, a generation ranges from 2-4 years). However, recovery could take even longer for a few species, such as common murres, that have declined or are declining.

IV.F.3.h. Nonendangered Marine Mammals

IV.F.3.g(1) Conclusion

The potential total loss of harbor seals and sea otters to a very unlikely 120,000-barrel oil spill could include perhaps 20-300 individual seals and small numbers of sea otters (perhaps 20-40 individuals) of the Southcentral Alaska sea otter stock. Recovery of the populations is likely to take more than 1 year to less than 5 years, depending on the population status at the time of the loss and other unrelated factors adversely affecting the population. The potential loss of cetaceans (10-20 individuals in a population or group) likely would affect some family groups (such as a killer whale pod) for more than one generation. However, such a loss to a population of whales or porpoises likely would to take about 1 year for the population to recover. For an analysis of potential effects on sea otters on the Alaska Peninsula and the Kodiak area, see the Section IV.F.3.f - Endangered Species.

IV.F.3.g(2) Effects of a 120,000-Barrel Blowout

This analysis assumes that a 120,000-barrel blowout spill occurs in Cook Inlet in LA2 during the summer or winter (Figure IV.A-1). Within 3 days, the spill is estimated to have swept over a discontinuous area of 70 square kilometers (Table IV.F-4); and a portion of the spill is estimated to have contacted harbor seal coastal habitats and haulouts primarily on the west side of Cook Inlet (LS's 29-36: Augustine Island north to Redoubt Point). Harbor seal haulouts in Chinitna and Tuxedni bays have the highest probabilities of spill contact (13% and 12%, respectively) within 30 days (Table IV.F-8). Within 30 days after the spill during the summer season, more of the spill is expected to contact coastal habitats of harbor seals and other nonendangered marine mammals south to Cape Douglas (LS 25) on the Alaska Peninsula, including haulout areas on Augustine Island (LS 29) and in Kamishak Bay (LS's 26-31) (see Map 16). If the spill occurs during the winter, harbor seal haulout areas along the Coast of Shelikof Strait on Afognak Island, the Alaska Peninsula have a chance (1%) of being contacted within 30 days (Table IV.F-8). Assemblages of harbor seals in Chinitna and Tuxedni bays or along the coast of Kamishak Bay or on Augustine Island are expected to be exposed to the spill and a number (perhaps 50-300 seals) of them likely would become oiled and absorb petroleum hydrocarbons through their skin and suffer physiological/toxic stress that might lead to the death of a number of oiled seals (perhaps 50-300 animals), with recovery from this loss taking place within more than 1 year to 5 years.

The assumed spill has a low chance (0-3%) of contacting lower Kenai Peninsula and Kachemak Bay habitats of Southcentral Alaska sea otters (Table IV.F-8: ERA's 47-50). If a portion of the spill contacted these areas, some sea otters could be exposed to part of the spill and suffer lethal effects. The number of Southcentral sea otters killed likely would be small (perhaps in the tens of animals killed) but numbers affected could range into the hundreds with recovery of the population ranging from less than 5 years up to perhaps 10 years. The spill is estimated to contact nonendangered cetacean offshore habitats in outer Kachemak and Kamishak bays (ERA's 3 and 4, respectively) and Tuxedni and Chinitna Bays (ERA's 1 and 2, respectively), with probabilities ranging from about 13-34% (Table IV.F-7). Harbor porpoises and minke and killer whales are likely to be exposed to part of the 120,000-barrel spill and to suffer some losses (such as a few individual animals). At 30 days, the spilled oil is expected to be very dispersed and at least partly weathered, with much of the toxic components lost; therefore, the losses of harbor seals and perhaps nonendangered cetaceans to oil contact at this stage of the spill are expected to be less than losses during the first 3 days of the spill.

Cetaceans within Cook Inlet, such as harbor seals, Dall's porpoises, and killer and gray whales, migrating along the coast of Kodiak Island and in Shelikof Strait at the time the spill contacts these habitats might encounter oil on the surface of the water when breathing and resting. These encounters likely would not result in mortalities unless the cetaceans encounter a very large, continuous slick of fresh, highly toxic oil from the spill and consequently inhale lethal amounts of toxic fumes, which resulted in the death of highly exposed whales or porpoises. The number of cetaceans lost to such possible encounters is expected to be few (probably 10-20 animals). If such losses occurred in a family group of killer whales, recovery could take more than one generation (such as more than 10 years). However, populations of killer whales, porpoises, and other cetaceans in the gulf likely would replace the loss of 10 individuals within 1 year.

IV.F.3.i Terrestrial Mammals

IV.F.3.i(1) Conclusion

A very unlikely 120,000-barrel blowout oil spill could result in the loss of some river otters (perhaps 20-50), brown bears (perhaps 10-20), and Sitka black-tailed deer (perhaps 10-20). River otters and brown bears that reside in areas that remain contaminated are expected be affected for more than 1 year (perhaps as long as 3-5 years for river otters). Sitka black-tailed deer on Afognak and Kodiak islands could be affected if the spill contaminated shorelines in Shelikof Strait; however, few animals (perhaps 10-20) likely would be oiled or eat oiled vegetation. The overall populations of river otters, brown bears, Sitka black-tailed deer and other terrestrial mammals in the sale area are not expected to be affected this blowout spill.

IV.F.3.i(2) Effects of a 120,000-Barrel Blowout

This analysis assumes that a 120,000-barrel blowout spill occurs in Cook Inlet in LA1 during the summer; the spill is estimated to have swept over 70 square kilometers of sea surface and oiled a estimated 277 square kilometers of coastline, exposing an estimated 222 river otters to the spill based on a density of 0.8 otters per kilometer of coastline (Bowyer et al., 1993) within 3 days. River otters frequenting coastal habitats that become oiled are expected to ingest oiled mussels and other oiled intertidal prey organisms. This exposure is expected to result in changes in habitat use and reduced diversity in food-source availability, leading to decreased body growth and fitness in coastal otters that are continually exposed to contaminated prey. These effects are expected to persist for more than 1 year (and up to perhaps 5 years). A percentage of these river otters (perhaps 20-50 otters) could be directly oiled by the spill or ingest enough oil through grooming and through ingestion of oiled prey to result in their death.

Within 3 days, the spill is estimated to have swept over a discontinuous area of 70 square kilometers (Table IV.F-4), and a portion of the spill is estimated to have contacted terrestrial mammal coastal habitats primarily on the west side of Cook Inlet (LS's 25 to 36: Cape Douglas north to Redoubt Point). Habitats in Chinitna and Tuxedni bays have the highest probabilities of spill contact (13% and 12%, respectively) within 30 days (Table IV.F-8). Within 30 days after the spill (if it occurred during the summer season), more of the oil likely would contact some coastal habitats south to Cape Douglas (LS 25) on the Alaska Peninsula including brown bear foraging habitats along the coast of Kamishak Bay (LS's 26-31) (Map 17). If the spill occurs during the winter, Sitka black-tailed deer habitat areas along the coast of Shelikof Strait on Afognak Island and other terrestrial mammal habitats on the Alaska Peninsula have a 1% chance of being contacted within 30 days (Table IV.F-8). Assemblages of brown bears along the coast of Kamishak Bay likely would be exposed to the spill, and a number (perhaps 10-20 bears) of them likely could become oiled and ingest hydrocarbons from contaminated clams, mussels, and carrion. These bears could suffer physiological/toxic stress that might lead to the death of a number of exposed bears (perhaps 10 animals), with population recovery from this loss taking place within 1 year.

Oil that might contact Afognak Island could contaminate kelp and other intertidal vegetation that may be eaten by Sitka black-tailed deer that winter along the island coast; however, few deer (perhaps 10-20) likely would be oiled or eat oiled vegetation.

River otters that inhabit the Alaska Peninsula-Kamishak Bay could suffer some direct losses (perhaps 10-20 animals) from the spill; and other river otters in oil-contaminated areas are expected to suffer sublethal effects that reduce their fitness and change their behavior and distribution for perhaps 1 year or longer (may be as long as 3-5 years). Some of the oil from the spill that contacts the Alaska Peninsula is expected to contaminate intertidal prey organisms of river otters and brown bears. This contamination would be expected to reduce the productivity of some river otters in oiled areas where the contamination persists for more than 1 year (perhaps 3-5 years), such as in mussel and clam beds.

IV.F.3.j. Economy

IV.F.3.j(1) Conclusion

A very unlikely oil spill of 120,000 barrels would generate 5,000 cleanup-related jobs for 6 months in the first year, declining to zero by the third year following the spill. Local communities would experience a tripling of housing rents for 1 year. This is substantially greater than for Alternative I.

IV.F.3.j(2) Effects of a 120,000-Barrel Blowout

Our estimate of employment to clean spills is based on the most relevant historical experience of a spill in Alaskan waters, the *Exxon Valdez* oil spill of 1989. It uses a ratio of workers to barrels spilled. For this case, it is 5,000 workers to clean up 120,000 barrels. The *Exxon Valdez* oil spill was 240,000 barrels. This spill generated enormous employment that rose to the level of 10,000 workers directly performing cleanup work in relatively remote locations. Smaller numbers of cleanup workers returned in the warmer months of each year following 1989 until 1992.

Numerous local residents quit their jobs to work on the cleanup at often significantly higher wages than they earned previously. This generated a sudden and significant inflation in the local economy (Cohen, 1993). Anecdotal information indicates that housing rents in Valdez in 1989 increased 25% in some cases to sixfold in others, and inflated rents continued into 1990. Prices of food and other goods increased only slightly (Henning, 1993, pers. commun.). Similar effects on the Kenai Peninsula Borough would be mitigated due to the likelihood that cleanup activities, including administrative personnel and spill-cleanup workers, would be located in existing enclave-support facilities. The number of workers actually used to clean up a possible 120,000-barrel oil spill would depend on a number of factors. These include what procedures were called for in the oil-spill-contingency plan, how well prepared with equipment and training the entities responsible for cleanup were, how efficiently the cleanup was executed, and how well coordination of the cleanup was executed among numerous responsible entities.

IV.F.3.j(3) Components of the Kenai Peninsula Borough Economy

Native residents of the Kenai Peninsula Borough traditionally have relied on subsistence activities. Although not fully part of the cash economy, subsistence hunting is important to the economy for those practicing subsistence and even more important to culture. For effects on these aspects, see Sections IV.F.3.l – Subsistence-Harvest Patterns and IV.F.3.m – Sociocultural Systems. Other components of the Borough's economy are commercial fisheries, recreation and tourism, sports fisheries, and activities in National and State Parks described in Sections IV.F.3.k, IV.F.3.n, IV.F.3.o, and IV.F.3.r, respectively.

IV.F.3.k Commercial Fisheries

IV.F.3.k(1) Conclusion

The occurrence of a very unlikely 120,000-barrel oil spill in lower Cook Inlet during spring is estimated to result in economic losses to the Cook Inlet commercial-fishing industry ranging from about 27-100% per year, if the fishery is closed for a whole year. Losses could occur for 4 years following the spill. Estimated losses to the Kodiak commercial-fishing industry could be greater in terms of lost income and may occur *over a longer period than would be estimated for Cook Inlet. These loss estimates do not include losses due to damage to boats and gear. Losses to the commercial fishing industry from a spill of this size occurring in winter likely would be much reduced.*

IV.F.3.k(2) Effects of a 120,000-Barrel Spill

A 120,000-barrel oil spill is about 26 times larger than that discussed for Alternative I. The occurrence of a spill of that size in Cook Inlet is certain to result in commercial fishing closures in much of Cook Inlet, Kodiak Island/Shelikof Strait, and possibly in some areas of the southern Aleutian Peninsula. While this would appear to increase the effect of a 4,600-barrel oil spill by a factor of 26, commercial-fishing closures often are based more on the perception of possible contamination and tainting at specific locations rather than on the actual spill size or the amount of area contacted. For this reason, the 4,600-barrel oil spill considered in Alternative I assumes that closure of similar waters as would be expected from a much larger spill, such as a 120,000-barrel oil spill. The primary difference in the effect of these two spills on the commercial-fishing industry would be in the amount of water and shoreline oiled (particularly to the south through Shelikof Strait) and in the length of time that all oiled areas would remain oiled and closed to commercial fishing. It is assumed here that the 120,000-barrel oil spill would result in commercial-fishing closures lasting at least twice as long as was discussed for Alternative I.

From 1991-2001, the value of the Cook Inlet commercial fishery ranged between about $33 and $115 million, and averaged $41 million for that period. These numbers include all fish taken from Cook Inlet waters, including those harvested by out-of-State residents in Cook Inlet. Based on the above, in any 2-year period when the value of the Cook Inlet commercial fishery is estimated to be about $33 million per year, a 2-year loss of about $9 million per year represents a 27% ($9 million/$33 million x 100) per year loss for 2 years. In a 2-year period when the annual value of the Cook Inlet commercial fishery is estimated to be closer to $115 million, a 2-year loss of $43 million per year represents a 37% per year loss for 2 years. However, a very large oil spill would preclude any knowledge of what the commercial fishery would have been worth that year had the spill not occurred. The value of the commercial fishery for the years affected by the spill is assumed here to be the average annual value of the Cook Inlet commercial fishery. It is possible the fishery could be closed for a whole season, resulting in a 100% loss for that year. In terms of the average annual value (about $41 million), a 2-year loss of about $9 million per year represents a 22% per year loss for 2 years to a 100% loss if the fishery is closed for an entire year. These loss estimates do not include losses due to damaged boats and gear. As indicated in the section on fish resources, a spill of this size is estimated to adversely affect less than 10% of the fish resources in the Cook Inlet sale area. Because about half of Kodiak's commercial-fishing income is derived from the Shelikof/Kodiak area, and the entire Kodiak commercial fishery is worth about twice that of Cook Inlet's (see Table IV.B-21), estimated losses to the Kodiak commercial-fishing industry would be about equal to that of Cook Inlet. However, these two areas are not equal in terms of the amount of economically productive commercial-fishing waters that are likely to be affected by a 120,000-barrel Cook Inlet oil spill, because the Kodiak/Shelikof area (a primary Kodiak commercial fishing ground) is the most likely place where the oil from a Cook Inlet oil spill would go (and remain). If the spill occurred in the spring, herring egg and fry losses could exceed 50% in the Shelikof Strait area. Because Kodiak currently supplies more than 11% of Alaska's commercial herring harvest (most of which comes from the Shelikof Strait area), closure of these waters would have a substantial adverse effect on the commercial-fishing industry in Kodiak In addition, commercial fisheries for salmon, halibut, and other groundfish (such as pollock) also occur in these waters. Therefore, the occurrence of a spill of this size and during this time of the year in Cook Inlet likely would substantially affect Kodiak's commercial-fishing industry for many years and likely would result in even greater losses than would occur in Cook Inlet. These loss estimates do not include losses due to damaged to boats and gear.

The occurrence of the spill during winter is likely to greatly reduce the extent of closures by the following spring and summer, because the effects of the remaining oil on fishes (and perceptions of tainting) would be much reduced by that time. Winter fishing closures in the areas where the oil spill occurred or contacted are possible; however, winter commercial fisheries are deepwater fisheries that are much less likely to be closed due to oil spills because of two beliefs that are generally accepted by most involved:

- First, winter weather in Alaska would quickly dissipate the oil (particularly the more toxic hydrocarbons) due to frequent winter storm activity.

- Second, adult fish and shellfish would not be contacted by hydrocarbons from the spill, because most hydrocarbons remain close to the surface. In addition, very little (if any) hydrocarbons would be likely to reach the zone where fishes are harvested during winter.

For these reasons, and the fact that there are far fewer ongoing commercial fisheries in winter, closure of winter commercial fisheries due to a large oil spill is much less likely than if the same spill that occurred in the spring. Hence, economic losses to the commercial-fishing industry due to a large winter oil spill are likely to be far less than what would be expected from that same spill occurring in the spring.

IV.F.3.I. Subsistence-Harvest Patterns

IV.F.3.I(1) Conclusion

Overall effects from a very large but very low probability spill on subsistence resources and harvests in subsistence communities in the region would be significant, if one or more important subsistence resources became unavailable. Based on the analyses of fish, birds, and marine and terrestrial mammal resources, this does not appear likely. On the other hand, the overall impact of a 120,000-barrel oil spill, combined with the effects still lingering from the Exxon Valdez oil spill, potentially could alter the overall subsistence round due to the potential for (1) displacement of resources, (2) contamination or perceived tainting of resources, (3) increased hunter effort due to displacement of resources, and (4) increased risk or cost to subsistence hunters that extends for longer than one harvest season. Harvesting, sharing, and processing of subsistence resources would continue but would be hampered to the degree these resources were contaminated. Tainting concerns in communities nearest the spill could seriously curtail traditional practices for harvesting, sharing, and processing resources and threaten pivotal practices of traditional Native culture. In the case of extreme contamination, harvests would cease until such time as local subsistence hunters perceived resources as safe.

IV.F.3.I(2) Effects of a 120,000-Barrel Blowout

Oil-spill contact from a 120,000-barrel oil spill near Kennedy Entrance in summer or winter could threaten subsistence resources and harvest patterns in the region. Beluga whales transit the region and are an important subsistence resource for the community of Tyonek. Even if belugas were not oiled in a spill, tainting concerns of subsistence whalers might cause them to further curtail their hunt, which already has been drastically reduced because of a recent sharp decline in the beluga population. In terms of overall population effects, losses to fish, birds, and marine and terrestrial mammals important to the subsistence hunt are not expected to be significant, but any losses of resources could be significant to the local harvest by subsistence-dependant communities. Just as with *the Exxon Valdez* oil spill, the instantaneous nature of the event would not permit opportunistic “stocking up” of available resources.

Even though subsistence-harvest levels have returned to pre-*Exxon Valdez* spill levels in all traditional communities of the region, and even though subsistence hunters have made nontraditional harvest adjustments to maintain these harvest levels, because of the effects on various resource populations from the *Exxon Valdez* oil spill, any additional resource losses would stress subsistence pursuits even more (Fall and Utermohle, 1999; Fall et al., 2001). Harvesting, sharing, and processing of subsistence resources would continue but would be hampered to the degree these resources were contaminated. Tainting concerns in communities nearest the spill could seriously curtail traditional practices for harvesting, sharing, and processing resources and threaten pivotal practices of traditional Native culture. In the case of extreme contamination, harvests would cease until such time as local subsistence hunters perceived resources as safe.

Overall effects from a very large but unlikely spill on subsistence resources and harvests in subsistence communities in the region would be significant if one or more important subsistence resources became unavailable. Based on the analyses of fish, birds, and marine and terrestrial mammal resources, this does not appear likely. On the other hand, the overall impact of a 120,000-barrel spill, combined with the effects still lingering from the *Exxon Valdez* oil spill, potentially could alter the overall subsistence round due to the potential for (1) displacement of resources, (2) contamination or perceived tainting of resources, (3) increased hunter effort due to displacement of resources, and (4) increased risk or cost to subsistence hunters that extends for longer than one harvest season.

Biological effects to subsistence resources might not affect overall species distributions or populations, but disturbance could extend the subsistence hunt in terms of miles to be covered, making more frequent and longer trips necessary to harvest enough resources in a harvest season. Specifically, the disturbance from oil-spill cleanup in the form of cleanup crews, boats, and aircraft, would increase the displacement of subsistence resources and alter or curtail subsistence-hunter access to traditional harvest areas.

In terms of fish resources, less than 10% in the Cook Inlet Planning Area are expected to be affected although floating eggs and larvae of fish and shellfish are the most likely to be affected. Pink salmon and herring eggs and fry would be at greatest risk due to the coastal spawning habits of adults. The reason for this relatively low percentage of resource affected is primarily because a 120,000-barrel spill is not likely to reach any large open ocean area with persistent toxicity levels (Malins, 1977), because spills are quickly dissipated on the open ocean. Additionally, the Cook Inlet and Kodiak/Shelikof regions support large migratory finfish populations that are not present during much of the year and that are widely distributed over the region. Hence, it is likely that a 120,000-barrel oil spill would affect a relatively small percentage of fish eggs and fry (less than 10%) in the Cook Inlet region; greater losses could be expected in the Kodiak/Shelikof area, which sustains higher herring populations.

For bird resources, the effect could result in the direct mortality of tens of thousands to possibly as many as 100,000 marine and coastal birds, depending on the time of year and the movement of the spill. The effects likely would be worse during the summer months because of the larger number of birds that occur in the area and the presence of nesting birds. If a spill swept through the coastal areas near Chisik-Duck Island (Tuxedni Bay) when rafting seabirds were congregating prior to breeding in the spring or during the fall, several thousand murres and other seabird species could be expected to be killed. If an oil spill contacted outer Kachemak Bay or Kamishak Bay, several thousand to perhaps as many as 100,000•sea ducks, shorebirds, and local seabirds could be expected to be directly lost to the spill. Additionally, oil contact with coastline and important intertidal areas would contaminate intertidal prey organisms of sea ducks and shorebirds, such as mussels. Such contamination is expected to affect productivity of local sea ducks. This contamination of habitat and resulting effects are expected to last for more than 1 year to a number of years after the spill. Cleanup activities also would be expected to cause displacement of nesting birds in the oiled areas and contribute to reducing reproductive success. Overall, the impacts on marine and coastal birds would depend on the number of birds involved, the season of the spill, and the movement of the spill in relation to bird abundance and distribution. Recovery could require two to five generations (from 2-4 years). However, recovery could take even longer for a few species, such as common murres, that are declining.

For important subsistence marine mammals (i.e., seals, sea lions), perhaps 20-300 individual seals could be lost. Recovery likely would take more than 1 year to less than 5 years, depending on the population status at the time of the loss and other factors adversely affecting the population. Based on the best available information, it is unlikely that large cetaceans would suffer significant population impacts from a large spill originating in Cook Inlet. Available information does not indicate that Steller sea lions would suffer significant acute impacts from a very large oil spill in Cook Inlet; a significant impact on the terrestrial component of sea lion critical habitat also is not expected. Marine mammals and birds also can be affected indirectly after a spill due to damage to prey resources.

Beluga whales, an important subsistence resource for the community of Tyonek, inhabit areas within and adjacent to the Cook Inlet Planning Area. In summer, belugas tend to concentrate in the upper areas of Cook Inlet and a large summer spill is not expected to reach traditional subsistence whaling areas. Their nonsummer range is less well defined, but they do venture into areas south of Kalgin Island, and varying numbers are typically seen in the Kachemak Bay area, including sightings in the spring in the mid-1990's in the Mud Bay area (Monnett, —, pers. commun.) and annual sightings between the Homer Spit and the head of Kachemak Bay (Field, — , pers. commun.). Based on these observations and the fact that the Nanwalek/Port Graham ERA 31 (Kachemak Bay/Outer Peninsula) has a probability of contact of 3% in summer and 4% in winter for 30 days, individual or small groups of whales could potentially be injured or even killed in a large spill. Other potential impacts include displacement from normal feeding areas, reduction in prey, or possible physiological impacts resulting in reproductive failure.

Perhaps 10-20 Sitka black-tailed deer, 10-20 brown bears, and similar numbers of other important subsistence terrestrial mammals (moose) would be lost from a 120,000-barrel oil spill. Animals that reside in areas that remain contaminated could be expected to be affected for more than 1 year. Sitka black-tailed deer on Afognak and Kodiak islands could be affected if the spill contaminated shorelines in Shelikof Strait, and they ate contaminated kelp or other intertidal vegetation. Overall populations of terrestrial mammals are not expected to be affected by the 120,000-barrel blowout spill. Contamination of intertidal mussel and clam beds would reduce the availability of shellfish resources.

This analysis assumes that a 120,000-barrel blowout spill occurs in Cook Inlet in LA1 during the summer or winter. Within 3 days, the spill is estimated to have swept over a discontinuous area of 70 square kilometers (27 square miles) and oiled an estimated 277 square kilometers (107 square miles) of coastline; oil from the spill could contact subsistence-resource and -harvest areas on the west side of Cook Inlet, which is home to marine mammal habitats and haulouts and important Tyonek fishing sites. Environmental Resource Area 1 (Tuxedni Bay) has a very high probability of contact (41% in summer and 27% in winter) within 30 days. Land Segments 36 (Redoubt Point) and 37 (Drift River) have a 7% and 1% probability of contact in summer for 30 days, but in winter the probability of contact is reduced for LS 36 to 3% and to less than 0.5% for LS 37 for 30 days. On the east side of the inlet, the potential for a spill contacting important Ninilchik subsistence resource areas remains low, with LS 44 (Deep Creek, Ninilchik) having a probability of contact of 3% in summer and 1% in winter for 30 days and LS 45 (Cape Starichkof, Happy Valley) having a probability of contact of 6% in summer and 6% in winter for 30 days. For Seldovia, LS 47 has a probability of contact of 3% in summer and 2% in winter for 30 days, and for Port Graham and Nanwalek, LS 48 has a probability of contact of 1% in summer and 2% in winter for 30 days. Nanwalek/Port Graham ERA 31 (Kachemak Bay/Outer Peninsula) has a probability of contact of 3% in summer and 4% in winter for 30 days. Important harvest areas for Ouzinkie and Port Lions are LS's 82 (Bluefox Bay, Shuyak Island, Shuyak Strait) and 83 (Foul Bay, Paramanof Bay). All other important subsistence environmental resource areas and land segments in all regions have less than a 0.5% probability of contact.

IV.F.3.m. Sociocultural Systems

IV.F.3.m(1) Conclusion

The effects of a very large, but very unlikely, oil spill on sociocultural systems would cause chronic disruption to sociocultural systems, with a tendency for additional stress on the sociocultural systems but without a tendency toward the displacement of existing institutions.

IV.F.3.m(2) Sociocultural Effects

A very large oil spill could affect sociocultural systems in a number of ways. The potential effects of the spill include those described for the 1500- or 4,600-barrel oil spill described in the analysis of the Proposed Action in Section IV.B.1.m. In addition, research of the long-term effects of *Exxon Valdez* oil spill (Fall et al., 2001; Impact Assessment, Inc., 2001) indicates the following effects may be realized from a very large spill:

- Communities highly dependent on subsistence ("wild") foods are most vulnerable to the effects from an oil spill. In these communities, self-identities and family life are organized to a larger extent around seasonal harvest distribution and use of foods. Cultural survival is tied to the traditional use of food.
- The level of distress and sense of loss increase with proximity to the spill and the degree of oiling.
- The lingering presence of oil in the environment leads to continuing avoidance of subsistence-harvest resources.
- The short-term depression of subsistence-food harvest and use did not lead to long-term sociocultural losses, such as loss of cultural knowledge, skills, or values within families. In fact, concerns about potential sociocultural effects led to intensification of economic and cultural revitalization as a social movement in communities.

- During cleanup, the effort of village residents was redirected from subsistence activities to wage-sector employment. In villages, labor often is redirected between cash/and noncash activities.
- The traditional organization of the subsistence sector was not eroded by the spill.
- Concern over contamination of subsistence resources persists, and confidence in the benefits in eating natural foods eroded.
- No major demographic changes occurred. Apparent outmigration of residents did not take place; there also was not a permanent inmigration. The surge of population with initiation of cleanup activities subsided with curtailment of those activities.
- Purchase of lands for conservation areas caused some loss of Native-Alaskans' land base, while it created opportunities for income and investment.

These conditions indicate that the very large oil spill did cause chronic disruption for a period of time after the spill but that exiting social patterns, although affected, were not displaced. That is, the social structure of villages, towns, and cities, while affected by a very large oil spill, continues and persists in the aftermath of the spill.

IV.F.3.n. Recreation, Tourism, and Visual Resources

This section examines the effects of a 120,000-barrel oil spill to the coastal-dependent and coastal-enhanced recreation, tourism, and visual resources of Cook Inlet caused by closure, physical degradation, and perceptual degradation of an area by an oil spill.

IV.F.3.n(1) Conclusion

A very large, but very unlikely, oil spill could cause significant effects to coastal-dependent and coastal-enhanced recreation and tourism values. These effects from closure and physical degradation would be limited to those areas where oil made contact and would last the duration of the cleanup. Effects from perceptual degradation could last longer and affect locations beyond the area oiled by the spill.

IV.F.3.n(2) Effects of a 120,000-Barrel Blowout

The potential effects of the spill include those described for the 1500- or 4,600-barrel oil spill described in the analysis of the Proposed Action, Section IV.B.1.n. Effects from the spill may be realized in three periods—closure, physically degraded, perceptually degraded.

Effects of a very large oil spill include alteration of aesthetic appreciation of the environs; viewing of wildlife species injured by the spill (for example, killer whales, sea otters, birds); and recreation use of beaches with oil residue. Sports hunting and fishing (see Section IV.F.3.o) also might be affected by closures. Recreation facilities could be damaged in the cleanup process. Indirect effects include a shift in tourist and recreational use to areas unaffected by the spill (Impact Assessment, Inc., 2001).

Analysis of the pattern of projected contact of the oil spill with land segments shown in Table IV.F-8 indicates that the coastal area of Lake Clark National Park and Preserve would be most affected by the spill during the high-use period (summer), with up to a 13% chance of contact with some land segments within 30 days of the spill. The area affected includes Chinitna Bay and Tuxedni Bay, where high-value, low-participation activities such as wildlife viewing is a major attraction. Shoreline cleanup efforts could restrict access to the shoreline, including landings by air- and waterborne sightseeing charters, and directly affect the attendant coastal-dependent and coastal-enhanced uses of the closed area. Restricted access would last the duration of the cleanup. The chance that recreation areas on Kalgin Island and the Kenai Peninsula (Table IV.F-8, ERA's 38-48) would be contacted after 30 days ranges between 1% and 6%. If the closure of any of these areas lasted more than 7.5 days, which is likely given the magnitude of the spill, during the peak season, the effect would be significant.

Once the area is reopened, recreational and tourism use could be degraded if the residual presence of oil prevents complete resumption of the activities. Oil residue on beaches degrades recreational use of those areas.

Perceptual degradation may last for a longer period after the spill, well after all values have been restored. The effect of perceptual degradation is that visitors avoid the area and substitute other locations for the affected area. Perceptual degradation may cause loss of recreation and tourism activity in the area affected and cause an increase in activity in other areas. The increased activity in other areas can have beneficial consequences (an increase in economic activity) or a negative consequence (overuse of existing facilities).

IV.F.3.o. Sport Fisheries

IV.F.3.o(1) Conclusion

We estimate that should a very unlikely oil spill of 120,000 barrels occur, it could eliminate sport fishing in Cook Inlet for 1 year. The total of all types of fishers—198,000 person-days of fishing—could be lost for 1 year. This figure includes 79,000 days on charters in lower and central Cook Inlet; 91,000 days on private or bare-boat charters; and 28,000 shore-based days. We estimate that $35 million (in 2000 dollars) could be lost by the sport-fisheries-related industry in 1 year—a significant impact. This is the total expenditure by all sport fishers fishing in lower and central Cook Inlet directly attributable to saltwater halibut and salmon fishing.

We estimate that a 120,000-barrel spill could affect up to 60% of the intertidal and shallow subtidal invertebrates (razor clams and other clams) in the sale area. Recovery of invertebrates could take up to 3 years in high-energy habitats and up to 7 years in low-energy habitats. Recovery of invertebrates in some subtidal and intertidal habitats could take more than a decade. The ability of people to collect razor clams and other clams in Kachemak Bay, Clam Gulch, and Kaligan Island could be affected correspondingly—a significant impact.

IV.F.3.o(2) Effects of a 120,000-Barrel Blowout

The person-days sport fishing in lower and central Cook Inlet during 1997 total approximately 79,000 on charters, 91,000 private or bare-boat charters, 28,000 shore-based, and 198,000 total of all modes. They include local, Alaskan (nonlocal), and nonresident of Alaska. The average daily expenditures for lower and central Cook Inlet sport-fishing trips in 1997 and 1998 ranged from $32 for a local resident fishing from shore to $294 for a nonresident of Alaska on a charter. These expenditures include auto or truck fuel, auto or RV rental, airfare, other transportation, lodging, groceries, restaurant and bar, charter or guide, fishing gear, fish processing, derby, boat fuel and repairs, and moorage or haul out. The total expenditures by all sport fishers fishing in lower and central Cook Inlet directly attributable to a saltwater halibut and salmon fishing trip in 1997 was $34 million (Herrmann, Todd, and Hamel, 2001).

We estimate a 120,000-barrel oil spill to eliminate sport fishing in Cook Inlet for 1 year based on the following. Sport fisheries were closed in 1989 as a result of the *Exxon Valdez* oil spill when oil drifted into Cook Inlet. In 1990 and thereafter, sport fishing was reopened. The sport fishing for salmon and halibut in Cook Inlet, and other areas where the oil spread for only one season, resumed in 1990 and thereafter. Perception of tainting lasted only for one fishing season. The total of all modes of sport fishing, 198,000 person-days of fishing, would be lost for 1 year: 79,000 days on charters in lower and central Cook Inlet; 91,000 days on private or bare-boat charters; and 28,000 day shore-based. We estimate $34 million in 1 year to be lost. This is the total expenditure by all sport fishers fishing in lower and central Cook Inlet directly attributable to a saltwater halibut and salmon fishing in 1997 dollars. It is $35 million in year 2000 dollars. See Section III.C.6 for details and references.

We do not anticipate any effect of a 120,000-barrel oil spill in Cook Inlet on the sport fishing on the rivers and streams flowing into Cook Inlet.

People gather razor clams and other clams at various locations on the shores of Cook Inlet. The effects on their ability to gather correspond to the effects of a 120,000-barrel oil spill on those species described in Section IV.F.3.c - Lower Trophic-Level Organisms. That is, a 120,000-barrel spill would affect up to 60% of the intertidal and shallow subtidal invertebrates in the proposed sale area. Recovery of invertebrates would take up to 3 years in high-energy habitats and up to 7 years in low-energy habitats. Ongoing studies of the *Exxon Valdez* oil spill in Prince William Sound (www.oilspill.state.ak.us) show that recovery in some subtidal and intertidal habitats take more than a decade.

IV.F.3.p. Environmental Justice

IV.F.3.p(1) Conclusion

Environmental Justice effects of a very large but very unlikely oil spill on low-income, minority populations in the Cook Inlet/Shelikof Strait area would focus on the Native, subsistence-based communities of the region. Environmental Justice effects on these communities could occur because of their reliance on subsistence foods, and because overall cumulative effects may affect subsistence resources, subsistence-harvest practices, and sociocultural systems. Oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health. The MMS believes that serious mitigation for such impacts begins with a commitment to preventing spills in the first place by employing the highest standards for exploration, development and production technology.

Potential effects would focus on the Native minority populations residing in the subsistence-based communities of upper Cook Inlet (Tyonek); the central Kenai Peninsula (Ninilchik and the Kenaitze Indian population in Kenai); the lower Kenai Peninsula (Seldovia, Nanwalek, and Port Graham); Kodiak Island (Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions); and the southern Alaska Peninsula (Chignik, Chignik Lagoon, Chignik Lake, Ivanof Bay, and Perryville). If a very large oil spill occurred and contaminated essential resources and harvest areas, major effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Such impacts would be considered disproportionately high adverse effects on Alaskan Natives. Any potential effects to subsistence resources and subsistence harvests from a large oil spill are expected to be mitigated to some extent but not eliminated.

IV.F.3.p(2) Effects of a 120,000-Barrel Blowout

This analysis assumes that a 120,000-barrel blowout spill occurs in Cook Inlet in LA2 during the summer or winter. Within 3 days, the spill is estimated to have swept over a discontinuous area of 70 square kilometers (27 square miles) and oiled a estimate of 277square kilometers (107 square miles) of coastline; oil from the spill could contact subsistence-resource and -harvest areas on the west side of Cook Inlet, which is home to marine mammal habitats and haulouts and important Tyonek fishing sites, as described in the following:

- ERA 1 (Tuxedni Bay) has a very high probability of contact (41% in summer and 27% in winter) within 30 days.
- Land Segments 36 (Redoubt Point) and 37 (Drift River) have a 7% and 1% probability of contact in summer for 30 days, respectively, but in winter the probability of contact is reduced for LS 36 to 3% and to less than 0.5% for LS 37 for 30 days.
- On the east side of the Inlet, the potential for a spill contacting important Ninilchik subsistence-resource areas remains low, with LS 44 (Deep Creek, Ninilchik) having a probability of contact of 3% in summer and 1% in winter for 30 days and LS 45 (Cape Starichkof, Happy Valley) having a probability of contact of 6% in summer and 6% in winter for 30 days.
- For Seldovia, LS 47 has a probability of contact of 3% in summer and 2% in winter for 30 days; and for Port Graham and Nanwalek, LS 48 has a probability of contact of 1% in summer and 2% in winter for 30 days.
- Nanwalek/Port Graham ERA 31 (Kachemak Bay/Outer Peninsula) has a probability of contact of 3% in summer and 4% in winter for 30 days.
- Important harvest areas for Ouzinkie and Port Lions are LS's 82 (Bluefox Bay, Shuyak Island, Shuyak Strait) and 83 (Foul Bay, Paramanof Bay).
- All other important subsistence environmental resource areas and land segments in all regions have less than a 0.5% probability of contact.

Oil-spill contact from a 120,000-barrel oil spill near Kennedy Entrance in summer or winter could threaten subsistence resources and harvest patterns in the region. Beluga whales transit the region and are an important subsistence resource for the community of Tyonek. Even if belugas were not oiled in a spill, tainting concerns of subsistence whalers might cause them to further curtail their hunt, which already has been drastically reduced because of a recent sharp decline in the beluga population. In terms of overall population effects, losses to fish, birds, and marine and terrestrial mammals important to the subsistence hunt are not expected to be significant, but any losses of resources could be significant to the local harvest by subsistence-dependant communities. Just as with the *Exxon Valdez* oil spill, the instantaneous nature of the event would not permit opportunistic “stocking up” of available resources.

Biological effects to subsistence resources might not affect overall species distributions or populations, but disturbance could extend the subsistence hunt in terms of miles to be covered, making more frequent and longer trips necessary to harvest enough resources in a harvest season. Specifically, the disturbance from oil-spill cleanup in the form of cleanup crews, boats, and aircraft would increase the displacement of subsistence resources and alter or curtail subsistence hunter access to traditional harvest areas.

Even though subsistence-harvest levels have returned to pre-*Exxon Valdez* oil spill levels in all traditional communities of the region, and even though subsistence hunters have made nontraditional harvest adjustments to maintain these harvest levels, due to effects on various resource populations from the *Exxon Valdez* oil spill any additional resource losses would stress subsistence pursuits even more (Fall and Utermohle, 1999; Fall et al., 2001). Harvesting, sharing, and processing of subsistence resources would continue but would be hampered to the degree these resources were contaminated. Tainting concerns in communities nearest the spill could seriously curtail traditional practices for harvesting, sharing, and processing resources and threaten pivotal practices of traditional Native culture. In the case of extreme contamination, harvests would cease until such time as local subsistence hunters perceived resources as safe.

The sociocultural impacts of an oil spill to Native Alaskan communities are interconnected with the subsistence lifestyle of these communities. Subsistence embodies the traditions of Alaskan Native culture with overlapping connections to other cultural, social, and economic institutions. In addition, some effects may be felt well beyond the villages, given the extensive subsistence-food-distribution networks that extend to members in other places. The damage to natural resources used for subsistence may result in a disruption of harvesting, processing, and sharing. Such damage can affect the essential connections between sociocultural factors of individual identity, social group, culture, and nature. Given the overarching importance of subsistence resources to the Alaskan Native communities, any significant impacts to subsistence resources could create attendant significant impacts to the sociocultural systems of villages.

IV.F.3.q. Archaeological Resources

IV.F.3.q(1) Conclusion

The effects of cleanup activities, vandalism, and wear and tear on onshore archaeological sites are estimated to be less than the Exxon Valdez oil spill case-study effects on archaeological resources (i.e., less than 3%), should a very large but unlikely oil spill occur. Although the less than 3% estimated disturbed sites is based on the actual experience of the Exxon Valdez oil spill, the effect on sites due to a large oil spill from a well blowout in Cook Inlet would depend on the significance of the sites disturbed. We would expect no significant effects on potential offshore archaeological resources from a large spill resulting from a well blowout.

IV.F.3.q(2) Effects of a 120,000-Barrel Blowout

A 120,000-barrel oil spill from an accidental blowout could impact beached shipwrecks or shipwrecks in shallow waters and coastal historic and prehistoric archeological sites. Oil spills and their subsequent cleanup could impact the archaeological resources of the Cook Inlet area directly, indirectly, or both. Protection of archaeological resources during an oil spill requires specific knowledge of the resource’s location, condition, nature, and extent prior to impact; however, large portions of the Cook Inlet coastline have not been systematically surveyed for archaeological sites. The sites that are known include National

Register sites within the western Kodiak Island area, the southern Kenai Peninsula, and the Alaska Peninsula.

Gross crude oil contamination of shorelines is a potential direct impact that may affect archaeological site recognition. Heavy oiling conditions (Whitney, 1994) could conceal intertidal sites that may not be recognized until they are inadvertently damaged during cleanup. Crude oil also might contaminate organic material used in C-14 dating and, although there are methods for cleaning contaminated C-14 samples, greater expense is incurred (Dekin, 1993). However, many other anthropogenic sources of hydrocarbons and other possible contaminants also exist, so caution should always be taken when analyzing radiocarbon samples from coastal Alaska (Reger, McMahan, and Holmes, 1992).

The major source of potential impacts from oil spills is the indirect effects that result from unmonitored shoreline cleanup activities. Unmonitored booming, cleanup activities involving vehicle and foot traffic, mechanized cleanup involving heavy equipment, and high-pressure washing on or near archaeological sites pose risks to the resource. Unauthorized collecting of artifacts by cleanup crewmembers also is a concern, although one that can be mitigated with effective training and supervision. As Bittner (1993) described in her summary of the *Exxon Valdez* oil spill: "Damage assessment revealed no contamination of the sites by oil, but considerable damage resulted from vandalism associated with cleanup activities and lesser amounts were caused by the cleanup process itself."

The numbers of archaeological resources that may be impacted by a 120,000-barrel oil spill in the Cook Inlet area probably would be less than those documented from the 250,000-barrel *Exxon Valdez* oil spill. Two studies of intertidal disturbance, the *Exxon Valdez* oil spill Cultural Resource Program and a paper on archaeological protection presented at the Atlanta meeting of the American Society for Testing and Materials, are in close agreement as to the effects of the spill on shoreline and intertidal resources. In the first study by Mobley et al. (1990), there were 1,000 archaeological sites in the area affected by the *Exxon Valdez* oil spill and about 24 of these, or 2.4%, were damaged (Mobley et al., 1990). In the second study (Wooley and Haggarty, 1993), a total of 609 sites were identified and of these, 14, or 2.3 %, were damaged. The findings of these two studies agree that less than 2.3%-2.4% of the sites in the area affected by the *Exxon Valdez* oil spill suffered damage.

Subarea plans that have been developed for several areas of Alaska, including Cook Inlet, outline procedures for addressing and mitigating potential impacts to archaeological resources should an oil spill occur (Alaska Regional Response Team, 1997). Interagency and regulatory aspects of oil spill archaeological site protection recently have been clarified. A programmatic agreement (Alaska Regional Response Team, 1997) specifies the Federal On-Scene Coordinator's role in protecting archaeological resources, the type of expertise needed for site protection, and the appropriate process for identifying and protecting archaeological sites during an emergency response. Under the agreement, the Federal On-Scene Coordinator's Historic Properties Specialist coordinates and directs the site identification and protection program, with consultation and cooperation of the Unified Command and other affected and interested parties.

In the unlikely event of a 120,000-barrel oil spill, the numbers of archaeological resources within the spill area that would suffer damage would probably be less than those documented for the *Exxon Valdez* oil spill (i.e., less than 2.3% to 2.4%). The magnitude of the impact would depend on the significance and uniqueness of the archaeological information lost. If significant archaeological information were lost, the impact would be significant; however, plans and procedures that have been developed for the Cook Inlet area to protect archaeological resources in the event of an accidental oil spill would serve to mitigate impacts.

IV.F.3.r. National and State Parks and Other Special Areas

This section examines the effects of a 120,000-barrel oil spill to the coastal-areas of those national parks, refuges, State parks, and other special areas that lie adjacent to the proposed sale area.

V.F.3.r(1) Conclusion

A very large, but very unlikely, oil spill could cause significant effects to the unique and intrinsic values of the subject areas. Effects could be long term, with Lake Clark and Katmai Parks most affected by such an oil spill. The public's perception of effects to the aesthetic and cultural value of the impacted areas also could be long term.

IV.F.3.r(2) Effects of a 120,000-Barrel Blowout

Sections IV.B.1.r and IV.B 1.n describe the potential for effects from the 1,500- or 4,600-barrel oil spill described in the analysis of the Proposed Action on the subject areas.

The effects of a very large oil spill on the intrinsic values of these special areas would be as follows:

- There would be immediate degradation of the areas coastal aesthetics.
- Large amounts of oil coupled with cleanup operations would diminish whatever experience the park, refuge, or recreation area visitor would like to enjoy.
- Although the actual physical effects of the spill would be limited to the coastal areas, the public's perception of effects may be applied to the entire region. Those who would like to enjoy a particular area's unique intrinsic and pristine qualities would feel such a prospect diminished.
- Oil sheens from relic hydrocarbons uncovered over time by tidal/storm action would tend to perpetuate the public's perception of degraded environment.

However, the Cook Inlet area is one of very high-energy tidal and current flows and, with time—certainly less than a decade—the regions intrinsic qualities would rebound.

With a spill of this magnitude, however, the entire lower Cook Inlet region could be exposed to oil contact, and it is likely that the Lake Clark and the Katmai National Park coastlines would be the most likely to be impacted.

IV.F.3.s. Coastal Zone Management

IV.F.3.s(1) Conclusion

Based on the low-probability of a120,000-barrel blowout spill, and on compliance with the MMS' existing regulations for spill prevention and response, no conflicts are anticipated. This conclusion recognizes the accidental and unlikely nature of such an event; however, for NEPA purposes, such an event and its potential impacts are analyzed in this EIS.

IV.F.3.s(2) Effects of a 120,000-Barrel Blowout

The Statewide standards, coastal district policies, and the analyses that accompany them in as described in Section IV.B.1.s remain relevant for this analysis. A spill of this magnitude would be accidental in nature and, for purposes of compliance with the Alaska Coastal Management Policy, is not considered a reasonably foreseeable event. However; the MMS operating regulations at 30 CFR 250 Subpart B - Exploration and Development and Production Plans and 30 CFR 254 - Oil-Spill Response Requirements for Facilities Located Seaward of the Coastline address these issues. Enforcement of these regulations should ensure that there is no conflict with oil-spill related policies.

SECTION V

ANALYSIS OF CUMULATIVE EFFECTS

BY RESOURCE

CONTENTS OF SECTION V

V. Analysis of Cumulative Effects by Resource

Section V presents the following in detail:

- The past, present, and reasonably foreseeable actions that we consider in the cumulative-effects analysis.
- The additive, synergistic, and countervailing effects of the Proposed Action and past, present, and reasonably foreseeable activities, by resource, and the incremental contribution of the Proposed Action to the cumulative effects.

V.A. INTRODUCTION AND GENERAL CONCLUSIONS

V.A.1. Introduction

To help determine the structure and scope of our cumulative-effects analysis, we were guided by our past experience in preparing cumulative effects analyses and by the National Environmental Policy Act (NEPA) (40 CFR 1508.7) and 1508.25(a)(2):

> 'Cumulative impact' is the impact on the environment that results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
>
> To determine the scope of environmental impact statements, agencies shall consider …. [c]umulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement.

A handbook issued by the Council on Environmental Quality, *Considering Cumulative Effects Under the National Environmental Policy Act, January 1997*, suggests, among other things, that the analyses:

> …determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative effects of other past, present, and future actions . . . identify significant cumulative effects…[and]…focus on truly meaningful effects.

As suggested by this handbook, we consider the following basic types of effects that might occur:

- "additive" (the total loss of animals from more than one incident),
- "countervailing" (adverse effects that are compensated for by beneficial effects), and
- "synergistic" (when the total effect is greater than the sum of the effects taken independently).

The publication *Guidelines for Environmental Impact Assessment in the Arctic* (Finnish Ministry of the Environment, 1997) indicates that a "cumulative impact assessment should be kept at reasonable and manageable levels" and, thus, need not be voluminous and exhaustive.

V.A.2. Structure of the Analysis

Based on a consideration of our past experience and these references, we designed our cumulative-effects analysis for this environmental impact statement (EIS) as a five-step process:

1. We identify the potential effects of Cook Inlet Sale 191 on the natural resources and human environment that may occur
    - in Cook Inlet offshore,
    - in the Cook Inlet basin onshore, and
    - along the transportation route within Cook Inlet and to export markets.
2. We analyze other past, present, and reasonably foreseeable future oil-development activity in Cook Inlet basin for effects on the natural resources and human environment that we found would be potentially affected by the two Cook Inlet sales.
3. We consider effects from other actions (sport harvest, commercial fishing, subsistence harvest, and recreational activities) on these same natural resources and human environments.
4. We attempt to quantify effects by estimating the extent of the effects (i.e., number of animals and habitat affected) and how long the effects would last (i.e., population recovery time).
5. To keep the cumulative-effects analysis useful, manageable, and concentrated on the effects that are meaningful, we weigh more heavily other activities that are more certain and geographically in the nearshore zone, and we analyze more intensively effects that are of greatest concern. We also focus our effort by using, where possible, guiding principles from existing standards, criteria, and policies that control management of the natural resources of concern (see the following). Where existing standards, criteria, and policies are not available, our experts use their best judgment on where and how to focus the analysis.

V.A.3. Guiding Principles of the Analysis

The Endangered Species Act of 1973 (ESA) and the Cook Inlet Sale 191 scoping process are appropriate vehicles to identify species that are potentially at risk from incremental cumulative effects from the Cook Inlet Sale 191. Effects on listed species identified for the two Cook Inlet sales by the National Marine Fisheries Service and the Fish and Wildlife Service under Section 7 of the ESA are covered by this cumulative-effects analysis. We also review the effects on each of the other species identified through scoping and include them, as appropriate.

We assess cumulative effects on those species listed as “endangered,” “threatened,” “proposed,” or “candidate” in Cook Inlet and in the Cook Inlet basin that the National Marine Fisheries Service and the Fish and Wildlife Service indicate that we should assess. We assess endangered and threatened species in more detail than proposed or candidate species. We assess other cumulative effects on natural resources and the human environment in these same areas but in less detail than listed species, unless we find that they are likely to be “significant cumulative effects” under the Council on Environmental Quality guidelines. We also include effects along migration routes of species, as appropriate.

The management of beluga whales in Cook Inlet and Steller sea lions by the National Marine Fisheries Service under the Marine Mammal Protection Act of 1972 provides for monitoring these species’ populations and managing/mitigating potential effects of development on these species. The management of sea otters by the Fish and Wildlife Service provides for monitoring of potential effects. The State of Alaska Department of Fish and Game monitors the natural cycles of caribou and moose populations with respect to subsistence and sport-hunting activities. The Biological Resource Division of the U.S. Geological Survey, along with the Alaska Department of Fish and Game, is continuing to monitor effects of the *Exxon Valdez* oil spill on shore birds and waterfowl. Marine and coastal birds also are an ongoing monitoring effort of the Alaska Maritime Wildlife Refuge by the Alaska Department of Fish and Game. These monitoring efforts provide a means of indicating if significant cumulative effects have occurred or are occurring to regulate hunting pressure and to develop measures to minimize effects.

Water quality in Cook Inlet is regulated and/or monitored through various permitting and regulatory programs administered by the Environmental Protection Agency; the Alaska Departments of Natural Resources, Environmental Conservation, and Fish and Game. These programs have been established to protect against the significant degradation of water quality associated with specific human/development activities. In evaluating the cumulative effects to water quality, we consider the collective impacts associated with permitted/regulated activities as well as other nonregulated activities and/or natural occurring events.

Air quality is regulated under the Prevention of Significant Deterioration permitting process. For sources located in the outer continental shelf (OCS) (such as the two proposed Cook Inlet sales), the Prevention of Significant Deterioration program is administered by the Environmental Protection Agency. For sources located in State waters and onshore, the Prevention of Significant Deterioration program is administered by the Alaska Department of Environmental Conservation. Minor sources of air pollutants are not subject to Prevention of Significant Deterioration permitting requirements. The analysis of cumulative effects to air quality in this EIS considers the contribution of major and minor sources of air pollution to the Cook Inlet basin.

Wetlands disturbances are mitigated through the Section 404 Regulatory Program under Section 404 of the Clean Water Act, administered by the U.S. Army Corps of Engineers. The *Memorandum of Agreement Between the EPA and the U.S. Army Corps of Engineers Concerning the Determination of Mitigation under the Clean Water Action Section 404(B)(1) Guidelines August 24, 1993* provides a sequence for mitigation that includes avoiding and minimizing of and compensating for wetland losses. The Memorandum of Agreement recognizes that in areas such as the Cook Inlet basin (with a high proportion of wetlands), minimizing wetland losses will be the primary method of mitigation. However, compensatory mitigation could be required for unavoidable losses to high-use wetlands. Minimizing wetland losses also includes selective use of surrounding wetlands over high-use wetlands, for example, minimizing the impact from the placement of fill material into waters of the United States. Therefore, potential cumulative impacts to wetland resources are tempered through Federal, State, and local regulatory programs. Including appropriate Best Management Practices and environmental conservation conditions to oil and gas leases and exploratory, development, and production phases substantially lowers the likelihood of collective development actions that result in potential significant impacts to wetlands. We analyze the potential impacts resulting from the placement of fill material and the potential impacts resulting from oil-spill scenarios.

For the human environment (recreational and commercial fisheries, industrial activities, subsistence activities, sociocultural systems, and the economy), we focus on oil-development activities in upper Cook Inlet and the Cook Inlet basin, potential development in lower Cook Inlet, and the industrial complex at Nikiski, because these are where the most significant cumulative effects are expected to be concentrated. We consider effects along the migration route of birds and mammals using the Cook Inlet basin. However, we also give some consideration to effects on the human environment along the transportation route.

"Essential Fish Habitat" refers to new regulations recently promulgated by the National Marine Fisheries Service that have greatly expanded the agency's jurisdiction from management in coastal areas to nonfishing activities far inland. Under these regulations, many nonfishing activities such as logging on the Kenai Peninsula in a watershed used by species managed by National Marine Fisheries Service and regional fishery management councils are now open to comment by the agency if those activities could potentially impact essential fish habitat.

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, and an accompanying Presidential memorandum, require each Federal Agency to make the consideration of Environmental Justice part of its mission. The existing demographics (race, income) and subsistence consumption of fish and game are discussed, any disproportionate environmental and health effects on Alaskan Natives are identified, and their effects are presented.

Executive Order 13084, *Consultation and Coordination with Indian Tribal Governments*, requires the MMS to consult with tribal governments on "Federal matters that significantly or uniquely affect their communities," so that an effective process is established that "permits elected officials and other representatives of Indian tribal governments to provide meaningful and timely input." We have met with local Native leaders to discuss subsistence issues and have established a dialogue on Environmental Justice with these communities.

The cumulative effects on archaeological resources can be minimized through required surveys, consultations with the State Historical Preservation Officer to identify potential archaeological sites, and requirements to plan and schedule activities to avoid these locations. We analyze the potential for disturbances of archaeological resources in Cook Inlet and the Cook Inlet basin as well as the potential effects from cleanup of oil spills along the transportation route.

V.A.4. Scope of the Analysis

Oil and gas activities occur on the OCS in Alaska, the Gulf of Mexico, and California and are cited in the most recent Five-Year EIS (USDOI, MMS, 2002). In this EIS, we evaluate the cumulative effects of migratory species in Cook Inlet that could be exposed to potential oil spills from transporting Alaskan oil along the U.S. west coast. To be consistent with the Five-Year OCS Oil and Gas Program, the Cook Inlet Sale 191 cumulative analysis also evaluates the effects for transporting oil by tanker within Cook Inlet. Activities other than those associated with oil and gas also are considered. We also include by reference certain cumulative effects that are more national in scope, for example, global warming and alternative energy development.

Oil and gas activities considered in the analysis include past development and production, present development, and reasonably foreseeable future development. Activities beyond the 15- to 20-year production life of the activities that could result from the two Cook Inlet sales are considered too speculative at this time to include in this analysis. Furthermore, we exclude future actions from the cumulative-effects analysis, if those actions are outside the geographic boundaries or timeframes established for the cumulative-effects analysis. We address uncertainty through monitoring, and note that monitoring is the last step in determining the cumulative effects that ultimately might result from an action.

V.A.5. Significance

As directed by the Council on Environmental Quality NEPA regulations (40 CFR 1502.16), we discuss direct and indirect impacts (effects) and their significance on physical, biological, and human social resources. The specific resource topics considered (for example, endangered species or water quality) are those that are listed here in the introductory paragraph. Our analysis considers the “context” and “intensity” of the impact as mentioned by the Council on Environmental Quality in characterizing “significantly” (40 CFR 1508.27). The context aspect considers the setting of the Proposed Action, what the affected resource may be, and whether the effect on this resource is local or more regional in extent. The intensity aspect considers the severity of the impact and takes into account such factors as whether the impact is beneficial or adverse; the uniqueness of the resource (for example, threatened or endangered species); the cumulative aspects of the impact; and whether Federal, State, or local laws may be violated. When considering cumulative effects, the geographic area and timeframe are extended to include past, present, and reasonably foreseeable activities. Overlapping zones of influence and the incremental contribution of the Proposed Action also are evaluated in the cumulative case.

V.A.6. General Conclusions

Conclusions about effects on specific resources follow later in this section. If the resources we assumed would be developed are indeed developed, then our general conclusions of this cumulative analysis are:

- Any discoveries and production of Cook Inlet oil resulting from Sale 191 would back out proportionally the amount of oil that is tankered from Valdez to the refinery at Nikiski. Valdez tankers presently make 25-30 trips per year to Cook Inlet.

- The incremental contribution of Sale 191 to the cumulative effects likely would be quite small. Construction and operations primarily would be concentrated in the nearshore zone, and oil output would be a small percentage (approximately 7%) of the total estimated Cook Inlet basin past, present, and reasonably foreseeable future production.
- The most likely number of large oil spills from current and reasonably foreseeable production that would occur in State and Federal waters in Cook Inlet is 0. Nevertheless, we have estimated that the contribution to a large spill from Sale 191 would be about 0.21 or about 36%. In the extremely unlikely case of more than one large spill, any subsequent spills are not expected to contact the same resources or to occur before those resources recover from the first spill.
- We estimate that no significant cumulative impacts would result from any of the routine activities associated with Alternative I for Sale 191. In the unlikely event of a large offshore oil spill, some significant adverse impacts could occur to biological resources, sociocultural systems, and Environmental Justice. Those resources that would be contacted by an oil spill are expected to recover within two to three generations. These same resources are not expected to be contacted by a subsequent oil spill prior to their recovery. The probability of such an event combined with the seasonal nature of the resources inhabiting the area make it highly unlikely that an oil spill would occur and contact these resources. A resource may be present in the area but may not necessarily be contacted by the oil. An oil spill could affect the availability of a resource, or the resource might be considered tainted and unusable as a food source. The potential for adverse effects to some key resources is of primary concern and warrants continued close attention. Effective mitigation practices should be considered in future projects.
- For the cumulative analysis in this EIS, effects of the other alternatives for Sale 191, if chosen, would be essentially the same. In this cumulative-effects analysis, we assess the estimated contribution of Sale 191 to the combined estimated effects of all the past, present, and reasonably foreseeable activities that are likely to affect the same resources. The effects and differences in effects among the proposed sales and their alternatives are so small, that we cannot distinguish measurable differences among the Proposed Action or other alternatives for each sale relative to the combined estimated effects in the cumulative analysis. Therefore, this cumulative-effects analysis for Alternative I for Sale 191 serves adequately as a cumulative effects analysis for any of the alternatives for either of the two sales, with the exception, of course, of the no-action alternative, which needs no cumulative-effects analysis under NEPA.

V.A.7. Other Information about Cumulative Effects

We recognize the importance of readily available abiotic standards to determine environmental quality. Abiotic measurements (for example, air and water quality) often provide a good indication of the quality of biological and cultural resources. We also recognize that as we move from the abiotic to the biotic to the human condition, the variables increase, making it more difficult to determine cumulative effects on the quality of life. Similarly, as we move from the terrestrial environment to the offshore environment, the variables of environmental quality increase. Migratory species present additional variables that reflect habitat and species condition outside the primary study areas. Humans introduce even more variables with their mobility and behavioral diversity. Hence, as we progress from abiotic to biotic, or from freshwater to marine, or from terrestrial and marine to sociocultural effects our analysis, by necessity, becomes more difficult and less conclusive.

We assessed cumulative effects in this EIS to determine whether these effects were additive or synergistic or had some other relationship. Additive or combined effects on specific resources often are difficult to detect and do not necessarily add up in the numeric sense of 1 plus 1 equals 2. It is much more likely that an additive or combined effect would be greater than 1 but less than 2. A synergistic effect, in theory, is a total effect that is greater than the sum of the additive effects on a resource. To arrive at a synergistic effect in this example, we would need to detect a total cumulative effect greater than 2. In the highly variable subarctic environment, where natural variations in population levels can exceed the impacts of human activity, such an effect would need to be much greater than 2 to be measurable or noteworthy.

While synergistic impacts have been demonstrated in the laboratory (for certain types of chemical reactions, for example), there is almost no evidence of such impacts occurring when dealing with biological resources in the arctic environment. We recognize that synergistic impacts could occur, but we found none for the Cook Inlet multiple sales, the EIS alternatives, or in our assessment of cumulative effects. In effects sections, where synergistic impacts were not specifically enumerated, it was because there were neither studies nor information that led us to specifically identify such impacts.

Concern about the potential for cumulative effects should be weighed with the following information:

Estimated oil and gas activities likely would have fewer impacts on the environment than those activities conducted in the early years of the region's development. More rigorous environmental standards and more environmentally prudent industry practices now exist, which include smaller facility "footprints," fewer roads, directional drilling from onshore, elimination of most discharges into the water, and better working relations with the local residents.

Current industry practices and the environmental state of the Cook Inlet region frequently are observed and assessed, and much of this information is available to the public. This information and the ongoing dialogue about environmental issues among Federal, State, and local government agencies; Native regional and village corporations; industry; interest groups; and the public should continue to increase environmental awareness and encourage environmentally sound practices that, in turn, should help reduce the potential for environmental damage.

Many of the lessons learned following the *Exxon Valdez* oil spill have been applied to oil and gas operations in the Cook Inlet area, including oil-spill-response planning, equipment, training, and periodic exercises. These initiatives were developed specifically to reduce potential oil-spill accidents and to lessen effects, should spills occur.

If a major oil spill occurred, there likely would be a slowdown in new development during which additional safeguards certainly would be put in place and new ideas of pipeline placement and design would be researched. Just as the additional safeguards and practices resulted from the *Exxon Valdez* oil spill, the likelihood of an additional oil spill from the same causative factors and to the same resources would be reduced. This emphasis on preventing a similar incident further would ensure the full recovery of those resources from the initial spill.

The actual size and location of future oil and gas developments in the Cook Inlet region are uncertain. The actual effects on natural resources and the human environment that may result from such developments also are uncertain. Nevertheless, we have developed our best estimate of what those activities and effects might be. However, it is likely that projected actions or effects may not happen in a way that fits neatly into the scenarios we have established for this EIS. The MMS expects to continue collecting and analyzing information about ongoing and future oil and gas developments in the Cook Inlet region. This will provide feedback to decisionmakers who could amend mitigation provisions, if appropriate, at a later date.

In Section V.B, we describe the activities and projects we consider in this analysis. These activities include past development and production, present development, reasonably foreseeable future development, and speculative development. Some activities beyond 20 years are considered too speculative at this time. Activities other than oil and gas activities also are considered. In Section V.C, we present the assumptions used by each resource specialist in the remainder of the analysis in that section.

V.B. ACTIVITIES CONSIDERED IN THIS CUMULATIVE-EFFECTS ANALYSIS

Recreation and commercial uses of the Cook Inlet basin include sport fishing and hunting, fish processing, guides, timber harvesting and restoration, mining and reclamation, agriculture and mariculture, recreation and tourism, and public works projects, along with oil and gas exploration and development (Section V.C, Tables V-11, V-12, and V-13). Of these, oil and gas development is the main agent of industrial-related change in the Cook Inlet area. Oil and gas exploration and production activities have occurred in the Cook Inlet basin for more than 50 years. In the late 1950's and the 1960's, several commercial oil and gas fields were discovered. Many of the commercial-sized fields discovered during this time are producing today. Presently seven oil fields on the Kenai Peninsula are producing about 30,000 barrels of oil per day. Seventeen gas fields currently produce more than 485 million cubic feet of gas per day. In 1999, nearly 11 million barrels of oil and 177 billion cubic feet of natural gas were produced from Cook Inlet gas fields. Offshore fields are presently tapped by 15 production platforms with three of these platforms shut down as a result of low production volumes. Fields on the Kenai Peninsula and offshore in Cook Inlet have produced a cumulative of 1.2 billion barrels of crude oil and 5.9 trillion cubic feet of natural gas (Table V-8).

Cook Inlet oil production, which peaked at 230 thousand barrels per day in 1970, declined to 33 thousand barrels per day by 1997. Production of oil is expected to continue to decline to about 7,000 barrels per day by 2003. Cumulative production between 1997 and 2003 will be an estimated 50 million barrels (State of Alaska, Dept. of Natural Resources, Historic Projected Consumption, 1998). Existing gas reserves are adequate only for about 12 years of current production (Larson, 2001).

Gas reserves in Cook Inlet in 1970 stood at about 8 trillion cubic feet and production was about 145 billion cubic feet per year. This excess of gas played against market conditions and there was little incentive to develop additional gas fields. Over time, these reserves have been slowly consumed. Some sources (Jepson, 2001) presently estimate that these developed reserves will be exhausted in about 2014. The reserve to production time for the gas industry in the lower 48 states is about 7 years with new resources being added at about the same rate. In the past, the overabundance of gas in the Cook Inlet basin has been a disincentive for exploration. Present economic conditions make gas profitable and a stimulus for increased exploration (Jepson, 2001).

In Cook Inlet, almost all of the currently known reserves are contained in what would be considered large or giant fields (more than 1 trillion cubic feet). The next phase of exploration and development of Cook Inlet basin should see a great number of smaller independent companies. The increased activity from independents is expected to drive exploration and development costs lower, especially for gas. Additional oil reserves may continue to be an elusive target in Cook Inlet (State of Alaska, Dept. of Natural Resources, 2001). More natural gas discoveries are expected as a result of the added exploration activity by independents in quest of the more abundant gas fields along with some oil discoveries.

As the emphasis in resource exploration begins to shift from oil to gas, the environmental consequences of this change should be beneficial to environmental concerns. The lower Cook Inlet area is relatively unexplored and still has potential undiscovered oil resources. The first Federal offshore lease sales in Alaska were held in 1976, offering areas for lease in the Gulf of Alaska. Three Gulf of Alaska sales from 1976-1981 and bonus bids of $670 million and 12 exploratory wells yielded no commercial quantities of oil. Two lease offering in Federal waters in Cook Inlet resulted in 13 exploratory wells drilled between 1977 and 1985, of which one was in Shelikof Strait, but all failed to find commercial quantities of oil or gas (Table V-3).

For our analysis, we have had to make an educated guess as to the resource potential resulting from the two Cook Inlet sales. The conceptual view of the future is highly speculative in an area where there has been little offshore success and the present development scenario may be overly optimistic, but we have factored into our cumulative analysis a commercial discovery and development as a result of the two Cook Inlet sales (see Appendix B).

We focus our impact analysis on the following:

- oil and gas discoveries that have a reasonable chance of being developed during the next 15-20 years;
- exploration and development of additional undiscovered resources (onshore and offshore) that could occur during the next 15-20 years;
- some exploration and development activities that could occur after the 15-20-years from future State and Federal lease sales;
- activities other than oil and gas such as sport and subsistence hunting and fishing, commercial fishing, tourism, and recreational activities; and
- transportation of oil to western ports that may affect migratory species.

Table V-1 lists Cook Inlet fields and discoveries. Tables V-3, V-4, and V-5 list the past and current lease-sale activities we consider in this cumulative analysis. Figure V.B-2 shows the location of fields and discoveries that are listed in Table V-2 and areas of exploration. "Fields" refers to a geologic structure with proven reserves that has been developed and is producing crude oil. Fields can contain numerous reservoir pools produced through a common infrastructure. "Discoveries" refers to a pool with potential reserves that has not been developed. Some discoveries require additional drilling to confirm that oil or gas is commercially recoverable (see Appendix B).

For purposes of this cumulative analysis, we divide oil and gas discoveries into the following categories:

- **Past Development/Production:** six fields and satellites, with Albert Kaloa, Birch Hill, Moquawkie, Pretty Creek, and West Fork located onshore and North Trading Bay located offshore.
- **Present Development/Production:** present ongoing discoveries include 12 onshore fields and 7 offshore fields. Onshore fields include Beaver Creek, Beluga River, Cannery Loop, Ivan River, Kenai, Lewis River, Moquawkie, Nicolai Creek, Sterling, Stump Lake, Swanson River, and Wolff Lake. Offshore fields include Granite Point, McArthur River, Middle Ground Shoal, North Cook Inlet, North Trading Bay, Trading Bay, and West McArthur River. An additional offshore site, Redoubt Shoal, with an oil resource estimate of 100 million barrels expected to begin production in late 2002.
- **Reasonably Foreseeable Future Development:** discoveries that might see some development-related activities (i.e., site surveys, permitting, appraisal drilling, or construction) within the next 15-20 years include the onshore areas of Falls Creek, Nicolai Creek, North Fork, and West Foreland. Potential offshore developments include Starichkof and Tyonek Deep. The Starichkof field in the Cosmopolitan Unit is in State and Federal waters and is expected to be developed from an onshore site.
- **Speculative Development:** there are presently no discoveries that would fall into this classification for the Cook Inlet basin. The oil and gas reserves discovered in the Cook Inlet basin are presently not a lingering issue of available infrastructure as these resources can more readily be explored and developed upon discovery, as needed.

V.B.1. Past Projects Considered in the Cumulative Analysis

Oil and gas exploration and development are the primary past activities that have occurred in the Cook Inlet basin; they began with discoveries in the late 1950's and 1960's. Most of these activities have occurred on State lands and offshore in State waters. Exploration peaked in about 1967. There were major discoveries offshore about this time with the McArthur River Field, which is ongoing and has produced over 1,000 billion cubic feet of gas and over 600 million barrels of oil. Of the 1.2 billion barrels produced, approximately 50% is from the McArthur River, 20% from Swanson River, and 30% from the other fields combined.

Exploration and production has continued to decline. The last commercial gas discoveries in Cook Inlet were the Cannery Loop and Pretty Creek gas fields discovered in 1979. While most of the emphasis has been in quest of oil, the last major oil discoveries were West McArthur River in 1990 with a reserve estimate of 3 million barrels and Tyonek Deep in 1991 with a reserve estimate of 25 million barrels. Some other excellent possibilities could be coming on line in the near future such as the recent discovery by Forest Oil at Redoubt Shoal with an estimated production potential of 100 million barrels of oil. With these few exceptions, the overall production of Cook Inlet has declined sharply since the days of the "big discoveries" in the 1960's (Figure V.B-1).

Most of the past oil and gas discoveries in the Cook Inlet basin still are producing, which would bring them into the present category of activities. There are a few sites—all onshore—that presently are inactive and shut in, which include Albert Kaloa, Birch Hill, Pretty Creek, and West Fork. The North Trading Bay Unit, which is located offshore in Trading Bay, produced oil from 1967-1992 but still is producing natural gas (Tables V-10 and V-2).

Federal waters in lower Cook Inlet have been explored with a total of 13 exploration wells, all within an 8-year period from 1978-1985. Four major companies participated in this effort and found no economically recoverable reserves. Twelve of these 13 exploration wells were in lower Cook Inlet and 1 exploration well was drilled in Shelikof Strait. Water depths for these exploration efforts ranged from 115-546 feet. All were drilled from temporary structures using jack-up rigs in shallower waters with semisubmersibles and drillships in the deeper waters (Table V-3). These and other past activities are listed in Table V-12.

V.B.2. Present Development and Production (Within the Next Few Years)

Because most oil and gas activities that have started in the past are continuing with respect to discoveries and production, we cannot make a clear distinction between these two timeframes. For analytical purposes, we have considered the discovery and initial production as a past event or activity and the ongoing aspects of these same projects as an ongoing and present-day condition. In making this connection between past and present activities, we have the opportunity to draw a time line or trend line that gives an indication of the expected future effects of these activities. In addition, with this time-line model, the exploration effort has shifted to undiscovered gas resources, which have become more economically important for the Cook Inlet basin.

Presently, all the major ongoing production sites offshore for oil are in Trading Bay, which includes oil production from Granite Point, McArthur River, Trading Bay, Middle Ground Shoal, and West McArthur River Units (Table V-2). From these offshore sites in Trading Bay, oil is brought by pipeline onshore to the west side of Cook Inlet and onshore south to the Drift River terminal. From there, tankers transport it across the inlet to the refinery at Nikiski. All of the oil from Cook Inlet is refined at the Nikiski refinery, which produces gasoline, propane, butane, jet fuel, heating fuel, and asphalt for Alaska markets. Any new oil discoveries and developments in Cook Inlet will back off any imports to the Nikiski terminal (see Section III.D - Oil and Gas Infrastructure).

We have included the Redoubt Shoal Unit being developed offshore by Forest Oil as a present development that is expected to commence in the fourth quarter of 2002 or the first quarter of 2003. The Redoubt Unit, originally discovered in 1968 by Pan Am Petroleum Company, has a present resource estimate of about 100 million barrels (Carlson, 2002, pers. commun.).

A chemical plant at Nikiski uses Cook Inlet natural gas as a feedstock to manufacture more than 5,000 tons of fertilizer per day. This plant is the largest fertilizer complex on the west coast of the United States with an annual production of 800,000 tons of urea and 1 million tons of ammonia fertilizer. The plant employs about 300 workers and is a major supplier to the agricultural industry in the western United States.

Liquid natural gas has been another major industry at Nikiski since 1969. Natural gas, primarily from the North Cook Inlet fields, presently supplies about 1.3 million barrels of liquefied natural gas to Japan each month. The process using supercooled methane results in a gas product reduced in volume by a factor of 632 to a liquid state. These shipments to Japan consist of two liquefied natural gas 80,000-cubic-meter tankers that make from 32-36 trips per year. The Environmental Protection Agency and Alaska Department of Environmental Conservation monitor air emissions and discharges into Cook Inlet have been authorized through the National Pollutant Discharge Elimination System permit process. These and other present activities are detailed in Table V-12.

V.B.3. Reasonably Foreseeable Future Development and Production (within the Next 15-20 Years)

The MMS has developed information about reasonably foreseeable future development and production. This category includes activities that are reasonably foreseeable within the next 15-20 years. These estimates vary greatly with other Cook Inlet basin assessments. According to the State of Alaska, Department of Natural Resources (2001), much of the Cook Inlet area is underexplored. The Alaska Oil and Gas Industry estimates that up to 90% of the region's recoverable oil reserves have been produced (*Alaska Oil and Gas Industry*, 2000).

In 2001, the oil and gas industry explored several different sites in Cook Inlet. The recent offshore exploration success and projected production from the Redoubt Unit by Forest Oil has been included as a present production activity (see Section V.B.2 - Present Development and Production). Other recent offshore exploration activity includes the Cosmopolitan Unit discovered in 1967 by Pennzoil. Onshore activity has included Falls Creek, Pretty Creek, Swanson River, Nicolai Creek, and North Fork Unit.

We estimate that these reasonably foreseeable future oil and gas activities would begin with the development of discoveries in close proximity to existing (past and present) fields to share infrastructure. Resource volumes are uncertain in this category. Generally, adequate drilling data and engineering studies are not available to define reserves to support development.

While the listing of reasonably foreseeable future developments includes only discoveries (see also Table V-7), significant amounts of oil could be produced by enhanced oil recovery from existing fields as well as from undiscovered satellite pools close to infrastructure areas. Enhanced recovery adds additional production from known reservoirs, creating "reserve growth." In addition, the industry has indicated that it has a large number of prospects very close to existing infrastructure that may become future satellite pools. Although both of these new resources (reserve growth and satellites) are as yet undiscovered, it is reasonable to assume that a significant portion would be brought into production in the next 20 years or sooner. For purposes of analysis, we have used the U.S. Geological Survey National Assessment for Cook Inlet of approximately 647 million barrels of oil (November 2001). We have estimated that half of this resource would be discovered and developed in the next 20-year period. To determine the onshore and offshore production distribution, we have applied the present ratio of existing onshore to offshore production in the Cook Inlet basin, which is about 1:10 (Table V-10).

These reasonably foreseeable future activities include eight discoveries that oil companies may begin to develop in the next 15-20 years. Offshore discoveries are Starichkof and Tyonek Deep. Onshore discoveries include Falls Creek, Ninilchik, North Fork, and West Forelands (Tables V-1 and V-2).

In other activities, British Petroleum Exploration (Alaska), Inc. is completing an experimental gas-to-liquids facility on the Kenai Peninsula near Nikiski. They company is scheduled to begin operations in June 2002 and employ about 15-30 persons. This process takes natural gas and converts it to a synthetic crude oil called syn-crude. They expect to produce about 300 barrels of synthetic crude (or "syn-crude") per day. This is new technology that will be using fuel-cell technology for power that is considered more efficient and produces fewer emissions than standard power supplies (Chappell, 2002, pers. commun.).

Another major project projected for the Kenai Peninsula is the Southern Intertie Power Transmission Project, a consortium of six utility companies serving Kenai to Fairbanks that will allow each company to buy and sell power as needed to essentially serve as backups to each other's power needs. Presently proposed are two routes in the Cook Inlet area. One route proposed by Enstar would be inland from Soldotna to Anchorage, and the other proposed by Tesoro would be along a coastal route to Anchorage. Cumulative impacts associated with these two corridors range from effects on biological to visual resources. These and other reasonably foreseeable activities are detailed in Table V.13.

V.B.4. Speculative Development (After 20 Years)

For this category, we look for small discoveries and undiscovered resources that are very unlikely to be developed in the timeframe of less than 20 years. With respect to undiscovered resources, it is not reasonable to estimate new infrastructure or predict the effects of development for prospects that have not been located or leased to industry for exploration. Accurate predictions of the location, size, or development schedule are not possible at this time. We have assumed for the Cook Inlet basin that any new commercial oil and gas discovery will not be delayed or put on an indefinite hold, which is an assumption quite different from those we made for the Beaufort Sea and North Slope where location and market conditions are more of a determining factor for development.

The leasing history for the Cook Inlet basin suggests that the majority of production is more likely to occur offshore. Any new development or additional oil production onshore is likely to occur in areas adjacent to existing infrastructure. Development of additional offshore resources in lower Cook Inlet should occur independently and not be dependent upon nearshore infrastructure.

Development of gas resources on the North Slope is included in the speculative category, although it may not affect future activities in Cook Inlet. Gas on the North Slope has been uneconomic to produce for several decades and may continue to be uneconomic in the future. Various plans have been studied to bring this resource online. Optimistically, gas sales from Prudhoe Bay could start as early as 2010. Estimates are that ample supplies exist in the Prudhoe Bay field to supply a large-scale gas export project for at least 20 years. The surrounding oil fields also have available gas resources that could feed into the North Slope gas transportation system. It is very unlikely that development of remote, undiscovered, and higher-cost gas resources would occur while there are adequate supplies of known, readily available reserves. The abundance of gas resources on the North Slope may or may not be developed in the foreseeable future. How any such development would affect gas exploration and development in the Cook Inlet basin is not known at this time, but we assume it would not be a negative or synergistic factor on potential cumulative effects.

The above four development categories represent all known oil and gas sources that potentially could be developed in the Cook Inlet basin. In this EIS, we focus on the first three oil and gas development categories and consider the fourth category (speculative) only with respect to possible seismic and associated exploration activities associated with future State and Federal lease sales. Other activities and issues are analyzed as they apply to particular resource topics. These areas of additional evaluation include cumulative effects from activities related to development in migratory overwintering ranges, environmental contamination, subsistence harvest, sport harvest, commercial fishing, marine shipping, tourism, and recreational activities.

V.B.5. Oil Production in Cook Inlet

V.B.5.a. Production Through 2000

Fields on the Kenai Peninsula and offshore in Cook Inlet have produced a cumulative of 1.2 billion barrels of crude oil and 5.9 trillion cubic feet of natural gas. Of this amount of oil production, about 233 million barrels are from onshore and over 1 billion barrels from offshore. The onshore gas production has totaled about 3.3 trillion cubic feet, and the offshore production has totaled about 2.7 trillion cubic feet (Table V-8).

V.B.5.b. Resource Estimates Used for This Cumulative-Effects Analysis

Tables V-9 and V-10 show the reserve and resource estimates we use for analyzing cumulative effects. We have settled on 140 million barrels of oil and 190 billion cubic feet of gas for the first development project in lower Cook Inlet. This will be the result of two sales (Sales 191 and 199) based in part on industry interest tempered with the knowledge and previous experience of this area. In addition, at current prices of $30 per barrel, the average undiscovered commercial pool size is 100 million barrels of oil (see Appendix B).

V.B.6. State Lease Sales Considered in this Cumulative-Effects Analysis

More than 6.3 million acres of State land have been leased in 43 State oil and gas lease sales in the Cook Inlet basin since 1959. Some of this acreage has been leased more than once, because some leases had expired or were relinquished. As of June 1, 2002, 802,765 acres were under lease in Cook Inlet. Offshore acreage totals 437,251 acres, and onshore acres total a few less at 365,514. Exploratory drilling has been conducted on just 8.5% of the tracts that have been leased. Of the 261 exploration wells drilled in the Cook Inlet basin as of year-end 1996, only 24 discoveries have been made for an exploration success ratio of 9.2%. Only 18 of these discoveries are producing, yielding a production ratio of 6.9%.

The present State 5-Year (May 2002-May 2006) Oil and Gas Program for Cook Inlet of five areawide lease sales includes unleased, State-owned lands located in the Matanuska and Susitna Valleys, the Anchorage Bowl, the western and southern Kenai Peninsula from Point Possession to Anchor Point, and the western shore of Cook Inlet from Beluga River to Harriet Point. A sale will be held each year beginning May 2002 and ending May 2006. The gross proposed area is about 4.2 million acres and is divided into 815 tracts. The actual number of tracts available for leasing will not be known until about 90 days before a sale.

V.B.7. Federal Lease Sales Considered in This Cumulative-Effects Analysis

Three lease sales and one reoffering sale have been held in the Cook Inlet Planning Area. Sales CI, 60, and 149 were held in October 1977, September 1981, and March 1997, respectively. Reoffering Sale RS-2 was held in August of 1982. These sales resulted in the issuance of 100 leases of which, all but two have been relinquished or have expired. Sale 88, originally scheduled for December 1984, was postponed and finally canceled in May 1986 for lack of industry interest. Sale 114 was cancelled to allow more time to assess the damages of the *Exxon Valdez* oil spill that occurred in Prince William Sound. Sale 149 in part replaced Sale 114. Sale 149 offered tracts in lower Cook Inlet and Shelikof Straits. Only two tracts were leased, but even though they have been made part of the Cosmopolitan unit, they have not been explored directly.

The present 5-Year OCS Leasing Program for 2002-2006 offers two sales in the Cook Inlet area. The first sale is scheduled for 2004 and the second sale for 2007. This area consists of approximately 517 whole and partial blocks, or about 2.5 million acres. Undiscovered oil on Cook Inlet OCS areas is estimated at 646.8 million barrels of oil. The production estimates for the two proposed sales, 191 and 199, in lower Cook Inlet is 140 million barrels of oil. The Secretary has decided to offer only the Cook Inlet portion of Cook Inlet/Shelikof Straits in this 5-year program.

V.B.8. Infrastructure and Transportation

The Cook Inlet basin has produced crude oil and natural gas since the 1960's. As a result, the area has a well-developed infrastructure for transporting petroleum at least in the upper Cook Inlet area. The lower Cook Inlet area lacks the oil and gas infrastructure of upper Cook Inlet, and exploration and development would require construction of onshore drilling pads and offshore platforms. Discoveries in this area would require construction of pipelines to connect with existing facilities (see Table V-4, Appendix B, and Section III.D - Oil and Gas Infrastructure).

V.B.8.a. Tanker Traffic and Routes

With potential development of a liquefied natural gas processing facility near Valdez, liquefied natural gas tankerage from Valdez to the Far East would join existing liquefied natural gas tanker traffic from the liquefied natural gas plant in Nikiski, Alaska. As indicated above, every 10 days the Nikiski plant loads a tanker with 80,000 cubic meters of liquefied natural gas for a round trip to Tokyo. This has been going on since 1968 without significant spillage. Because liquefied gas would boil off and disperse quickly when exposed to normal air temperatures and winds in the North Pacific, it is not considered a major environmental threat along the tanker route. A liquefied natural gas accident of major proportions could result in a large vapor cloud, which would be extremely dense and could ignite at the perimeter with the right mix of air with secondary explosions from other sources, but this highly unlikely event for the industry has no recorded occurrence.

Tanker traffic in the Inlet currently carries oil produced from the west side of the Inlet to the east side of the Inlet to be refined and delivers refined petroleum products from the Nikiski complex to other areas of Alaska. A total of 527 tanker trips from the Drift River facility between 1980 and 1992 moved more than 192 million barrels of Cook Inlet crude oil. A total of 806 loadings delivered more than 132 million barrels of North Slope crude oil to the Chevron and Tesoro refineries at Nikiski. Chevron closed its refinery in July 1991. Tankers presently move 8.2 million barrels, with an average cargo of 290,000 barrels, for about 25-30 trips per year from the Drift River facility to the Tesoro refinery in Nikiski. Tesoro also is processing about 7.3 million gallons per year of North Slope crude oil at Nikiski, which is tankered from Valdez in about 25-30 trips per year. Any new oil discoveries in Cook Inlet will back-out proportionally the Valdez imports, as North Slope crude is a less desirable feedstock for a refinery (Noel, 2002, pers. commun.).

On November 28, 1995, President Clinton signed legislation (30 U.S.C. 185(s)) that authorizes exporting crude oil from Alaska's North Slope in U.S. flag tankers, unless the President finds exports are not in the national interest. Figure V.B-3 shows the general route that tankers bound from Valdez to the Far East travel. They could carry up to 1.8 million barrels each; however, such estimates are highly speculative, because they depend on opportunities for short-term contracts. The routing shown in Figure V.B-3 brings the tankers more than 200 miles offshore of the Aleutian Islands—a distance that should protect the biological resources of the Aleutian Chain from pollution.

V.B.8.b. Natural Gas Projects

Development of the major North Slope gas resources, while still not a certainty, could reduce some of the present incentive of the industry to explore for gas in the Cook Inlet basin and also reduce oil exploration and production, which is becoming more incidental to gas exploration. Natural gas is being considered for transport three ways:

1. as pressurized natural gas (Alaska Natural Gas Transportation System),
2. as liquefied natural gas (liquefied natural gas), and
3. as "white gas" from a gas to liquids (gas-to-liquids) process.

The gas-to-liquids process converts natural gas to a high-quality crude oil with a plant in Nikiski expected to begin operations in June 2002 (Table V-13). The liquefied natural gas system of transport from Prudhoe Bay to Valdez and export to Japan could have an effect on Cook Inlet liquefied natural gas exports to Japan.

If the price per barrel of crude oil remains between $20 and $30, building a gas-transportation system may be viable. The latest of a variety of proposed systems would be designed to deliver natural gas from the North Slope at up to 2.3 billion cubic feet per day to a liquefaction plant in Valdez. The natural gas would be moved through a 42-inch pipeline built next to the Trans-Alaska Pipeline. The proposed project would consist of a plant to liquefy about 2 billion cubic feet of natural gas per day, four tanks to store 3,200,000 barrels of liquefied natural gas, a marine loading area, and a dock for loading cargo and personnel. The liquefied natural gas plant most likely would be in Anderson Bay, 3 miles east of the Valdez narrows on the south shore of Port Valdez (other options are being considered). The site is 3.5 miles west of the existing Trans-Alaska Pipeline System terminal and 5.5 miles from Valdez. When completed, it would occupy 390 acres of a 2,630-acre site owned by the State. A fleet of 15 liquefied natural gas tankers is anticipated would be available to carry 125,000 cubic meters of liquefied gas per trip to destinations in Japan, Taiwan, and Korea. Full development would require 275 liquefied natural gas tanker loadings a year (Federal Energy Regulatory Commission, 1995). A final EIS was issued for the plant in March 1995, but no agreements exist among the resource holders.

Given the uncertainty associated with construction of such a transportation system in the foreseeable future, we have not included that assumption in this cumulative analysis and have assumed no change in the present shipment and supply of liquefied natural gas from Cook Inlet to Japan. For more information on the Trans-Alaska Gas System and other projects that could move gas from the North Slope to market, see Table V-6.

V.B.8.c. Pipeline Transport

Pipelines have been in operation in Cook Inlet in both offshore and onshore environments since the 1960's. Existing infrastructure includes 5 onshore and 14 offshore crude oil pipelines systems, with a total of about 156 miles of pipe. About 84 miles of pipeline transport crude oil from offshore platforms to shore. After processing, the oil is further transported through two onshore pipelines to the Nikiski marine terminal on the east side of the Inlet or to the Drift River marine terminal on the west side of the Inlet (see Table V-4 and Section III.D) (State of Alaska, Dept. of Natural Resources, 1999).

Pipelines have been designed for the life of the field, which does not mean that the pipeline is unsafe after that initial period. The integrity of an older pipeline is a function of how well the line has been maintained and the type of throughput. With proper maintenance, the life of a pipeline can be several multiples of the original design life (Belmar Management Services, 1993). A 14-inch pipeline can store about 1,000 barrels per mile of pipeline length. For example, if oil were lost from a 5-mile length, a maximum of 5,000 barrels of oil could be discharged if the entire volume of oil in the segment drained from the pipeline (State of Alaska, Dept. of Natural Resources, 1999).

Gas pipelines also have been operational in Cook Inlet since the 1960's and are even more extensive than oil pipelines. Offshore gas pipelines concentrated primarily in Trading Bay total about 124 miles in length. Some of these are double lines, which would bring the total to about 180 miles. Onshore gas pipelines on the Kenai Peninsula total about 200 miles, and when double lines are added, the total is about 280 miles. On the west bank of Cook Inlet, the onshore gas pipeline's total length is about 160 miles. The total length for all gas pipelines is about 624 miles (see Section III.D and Table V-4).

V.C. ANALYSIS OF CUMULATIVE EFFECTS BY RESOURCE

V.C.1. Assumptions Used in the Analysis

The analysis of cumulative effects differs from the analysis of Alternative I for Cook Inlet Sale 191, in part because it considers an expanded geographic area and extended timeframe. This is needed to include additional effects on the physical, biological, and human environments of development of the oil and gas discoveries and other activities described in Sections III and IV. The geographic area is further expanded to include the migratory and transitory nature of many resources. The timeframe includes development of discoveries that may occur during the next 15-20 years and exploration activities for new discoveries over the next 30-40 years.

The cumulative-effects analysis further differs from the alternative-effects analysis by assessing the combined effects of past, present, and reasonably foreseeable future activities. To determine the effects of the alternatives (Section IV.C), we used the existing environment (Section III), as a baseline. However, this is not appropriate for cumulative-impact assessments, because it makes the effects of past and present actions part of the baseline rather than contributing to cumulative impacts (McCold and Saulsbury, 1996). The NEPA requires us to describe the incremental contribution of the proposed lease sales to the existing baseline at the present time. This baseline changes over time with additional uses, and the NEPA also requires an accounting of the environment over time. This means that our baseline for this cumulative-effects analysis must include past, present, and reasonably foreseeable activities. In the cumulative analysis, the incremental contribution of the proposed activity is relatively small and may be further reduced in significance as new activities are factored in. There is, however, greater uncertainty in determining cumulative effects than in determining the individual project-specific effects. We recognize the importance of ongoing environmental change and attempt to quantify the factors causing this change, including recovery, and identify thresholds of environmental response, when possible.

V.C.1.a. Summary and Significance of Past Spill Events in Cook Inlet

Past spill records are incomplete, but the health of the Cook Inlet ecosystem is good.

Offshore pipeline spills greater than 1,000 barrels occurred from Platforms A and B in 1966, 1967, and 1968 and ranged from 1,000-1,400 barrels. All pipeline spills were from vortex shedding as a result of harmonic vibration set in motion by the strong tidal currents. This problem has since been solved. Tanker spills in Cook Inlet include seven spills greater than 1,000 barrels from 1966-1989, four of which occurred near Nikiski, one near Drift River Terminal, one near Anchorage, and one near Kenai. These tanker spills were diesel fuel (two), crude oil (three), and jet fuel (two). Platform blowouts consist of three gas blowouts occurring in 1962, 1985, and 1987. No platform oil blowouts have occurred. (See Appendix A.1 for more detail).

Although the above past events may seem unacceptable to some, it is important to put this past activity into perspective. These events have occurred over a 36-year period in a dynamic circulation regime dominated by tidal flushing. We believe the pipeline engineering challenges of the rigorous circulation forces in the inlet have been solved. In addition, the numerous monitoring studies over this period looked hard for but found no measurable sustained effects or degradation in the quality of the marine environment from any of these activities. (For a brief recap of these monitoring efforts see Section V.C.5.a - Water Quality).

V.C.1.b. Differences in Cumulative Effects from Sale 191 Activities Compared to Sale 199

Although this EIS evaluates the potential effects of holding two proposed lease sales (Sales 191 and 199) in the lower Cook Inlet basin, the decisions that follow the completion of the EIS will focus on each individual sale. The first decision will be whether to hold Sale 191 as proposed, to modify the area offered, or to not hold the sale at all (Alternative II - No Lease Sale). Therefore, the cumulative analysis that follows will evaluate the contribution of Alternative I for Sale 191 to the cumulative effects under the assumption that the one 140-million barrel commercial discovery is estimated for Cook Inlet as a result of either one of the sales or both collectively. Because the effects from Sale 199 are estimated to be essentially the same as those for Sale 191, we will not present a separate cumulative-effects analysis for that sale. Instead, we will depend on the cumulative-effects analysis for Sale 191 to avoid unnecessary duplication.

No large oil spills greater than 1,000 barrels are expected from current and future production in the cumulative case; nevertheless, we have assumed a single large spill. This would result in the same analysis as the Proposed Action. Because there are no additional large spills of 1,000 barrels or greater in the cumulative case and to avoid unnecessary redundancy, the analysts have referenced this previous section and included only those cumulative activities or perturbations that would contribute to any additional or higher effects in the cumulative effects.

V.C.1.c. Oil Spills and the Incremental Contribution of the Proposed Action in the Cumulative Analysis

A key element in oil-spill analysis is an assessment of risk. Risks mean different things to different people. One of the fundamental problems when using quantitative risk analysis is related to the way the results of the analyses are expressed and interpreted. People evaluate risks in incompatible ways, based on their value systems (Thompson and Dean, 1996) and their perceived degree of exposure to a potential risk. Oil spills have high levels of "dread potential" (Slovic, 1987) because of their potential to produce consequences in the event of accidents, even though such events are estimated to have low-occurrence probabilities. The MMS recognizes that some stakeholders might wish to reduce the chance of a spill occurring, while others may consider any chance of a spill occurring as unacceptable. Still others may find the small chance of a spill occurring as an acceptable tradeoff for the benefits derived from oil and gas production.

To calculate the effects of habitat disturbance from activities associated with oil and gas exploration and development in the Cook Inlet basin, we use the total volume of oil produced in the past, present, and reasonably foreseeable future as an indicator. In general, there is a correlation between the volume of oil produced and the amount of habitat disturbance. From this volume of 1,978 billion barrels of oil, we calculate the incremental contribution of the Cook Inlet Sale 191 to habitat disturbance to be 7.0% (Table V-9).

To calculate the likely number of estimated oil spills greater than or equal to 1,000 barrels in our analysis of cumulative effects, we decided to use the midrange production estimate, which includes our estimate of past, present, and reasonably foreseeable future production for the Cook Inlet basin. To determine the number of oil spills we expect from current and future production, we multiply the offshore and onshore reserve estimates by the spill rate per billion barrels produced. The most likely number of offshore oil spills from present and reasonably foreseeable future activities is estimated to be zero. Likewise the most likely number of spills from proposed Cook Inlet Sale 191 is zero (Table V-15). The mean number of estimated offshore spills from such activities for the Cook Inlet basin over the life of the development project that could result for Sale 191 statistically is 0.58, of which Alternative I for Sale 191 is estimated to contribute statistically 0.21, or about 36%.

V.C.1.d. Reduction of Crude Oil Tankering from Valdez and Other Transportation Assumptions

Our analysis of possible oil spills from tankering includes tankering within Cook Inlet between Drift River and Nikiski and tankering of North Slope crude oil from Valdez into Cook Inlet. Oil produced from Sale 191 would reduce proportionally the crude oil tankered to Cook Inlet from Valdez. We also analyze spills from the Trans-Alaska Pipeline System (TAPS) tankers moving oil from Valdez to the U.S. west coast for those migratory species that use the Cook Inlet basin that may come in contact with TAPS tanker spills. The most likely number of oil spills greater than or equal to 1,000 barrels from TAPS tankers is nine. We estimate six spills with an average size of 4,000 barrels, four of which occur in port and two at sea. We assume two spills at sea, each with an average size of 13,000 barrels. Finally, we assume one large, highly unlikely spill in the Gulf of Alaska of 250,000 barrels that could extend into Cook Inlet.

In-port spills, where contingency measures are in place, would be cleaned up relatively quickly. Spills originating 80-100 nautical miles offshore would have a 5-10% chance of contacting the shoreline within 30 days (LaBelle and Marshall, 1995). The National Oceanic and Atmospheric Administration has initiated recent new shipping lanes and port routes that require tankers to travel at least 50 nautical miles offshore central California to better protect three marine sanctuaries of Monterey Bay, the Gulf of the Farallones, and the Channel Islands. The estimated six spills at sea and the one larger spill are not expected to occur within the same location or contact the same resources before recovery of the affected resource. Recovery periods would be lengthened if more than one spill affected the same population within a short interval, an unlikely situation.

The analysis of each resource has been weighed with respect to past, present, and future activities, as appropriate, to best predict the effects of Alternative I for Sale 191on that resource. For instance, for a species that has experienced stress from past and present environmental factors and human activities, and such stress is likely to continue in the future, would be a major focus of this analysis. Thus, the effects from offshore leasing in the Cook Inlet area would be a major concern. Effects from past oil and gas activities and those presently ongoing are part of the present population condition.

As indicated, future actions resulting from the development of existing discoveries are on a certainty scale of past development (those currently in production), present development (within 10 years), reasonably foreseeable future developments (within 10-20 years), and speculative development (after 20 years). The most heavily weighed are those past and present ongoing activities offshore in upper Cook Inlet; this area includes seven offshore production sites: Granite Point, McArthur River, West McArthur River, Middle Ground Shoal, North Cook Inlet, North Trading Bay, and Trading Bay. These are all major offshore fields discovered in the 1960's and still producing oil and gas. An additional offshore site, Redoubt Shoal, is expected to begin production in late 2002. Onshore in the upper Cook Inlet basin are 12 presently ongoing production sites at Beaver Creek, Beluga River, Cannery Loop, Ivan River, Kenai, Lewis River, Moquawkie, Nicolai Creek, Sterling, Stump Lake, Swanson River, and Wolf Lake (Table V-1). Of these onshore developments, only Beaver Creek and Swanson River are producing oil. The offshore environment of the Cook Inlet basin has produced 2,706 billion cubic feet of gas (about 45%) of the total gas production, and 1,002 million barrels of oil (about 81%) of the total oil production in Cook Inlet (Table V-2).

Next in consideration of offshore activities are the reasonably foreseeable future developments, which include nine potential production projects. Four of these projects are onshore and include Falls Creek, North Fork, Ninilchik, and West Forelands. North Fork had a previous production period of gas and may be revisited by the industry. Offshore there are two potential production sites at Tyonek Deep and Starichkof. The Starichkof field in the Cosmopolitan Unit is in State and Federal waters and would be developed from an onshore production site (Table V-1).

V.C.2. Analysis of Cumulative Effects by Alternative

The Council on Environmental Quality NEPA regulations recognize the cumulative problem as complex and require, along with the Proposed Action and other alternatives, an analysis of cumulative effects. Because the incremental contribution of a proposed action usually is small and each new project can affect or add to the baseline condition, Congress covered this contingency with the cumulative analysis. The purpose of the analysis was a consideration of where we had been and where we were going with development of our resources. This analysis is on a scale of projects past, present, and in the reasonably foreseeable future of the next 15-20 years. This scale puts in perspective the sensitivity of the cumulative analysis. This means that impacts that can be identified in the analysis of a proposed project might, or more than likely might not, translate to an effect in the cumulative analysis.

An example of scale is the planning area lease-sale EIS, with major tract-deletion alternatives. These large tract deletions can result in some measurable reduction in effects for some resources; however, even for many of these resources, there is no change in the effects. The cumulative effects for each alternative, even in these large lease-sale areas in Alaska, have never been considered to yield any useful information, because there never has been a measurable effect of an alternative at the cumulative level. This would be especially true for the proposed Cook Inlet sales, where the deferral alternatives are limited and the effects of the Proposed Action are not expected to be of a magnitude that would translate to a cumulative effect.

The extended geographic scale and timeframe of the cumulative analysis reduces the sensitivity of this analysis and treatment of alternatives. In the case of migratory birds, fishes, and mammals, the extensive geographic range of some of these species includes factors far removed from the site of the Proposed Action that can be limiting to the resource that spends most of its time in the zone of influence of the Proposed Action. When projecting the past and future impact on the resource, the extended timeframe further reduces the sensitivity of the cumulative analysis to the importance of the Proposed Action. It is even less likely to detect a measurable change from the respective alternatives that are proposed for Cook Inlet Sales 191 and 199.

In summary, the alternatives for the Cook Inlet Sale 191 have not been analyzed for cumulative effects, because the alternatives show very little change in the level of effects identified the Proposed Action. This is to be expected, because the level of impacts from the Proposed Action for Cook Inlet Sale 191 is very small in absolute terms and even smaller relative to the effects of past, present, and reasonably foreseeable future activities. The measurable effects of the Proposed Action do not necessarily translate to measurable effects in the cumulative analysis because of the larger geographic scale and timeframe required for the cumulative analysis, and because most resources recover from localized environmental effects. The alternatives offer some change in the level of effects relative to the Proposed Action but may not be measurable in this cumulative analysis of Cook Inlet Sales 191 and 199. Therefore, this cumulative analysis for Alternative I - Proposed Action for Sale 191 serves adequately as a cumulative-effects analysis for any of the alternatives for either of the two sales, with the exception of course of the no-action alternative, which needs no cumulative effects analysis under NEPA.

V.C.3. Supporting Information

The following cumulative analysis builds on information contained elsewhere in this EIS. Section IV.C contains our analyses of potential effects. Section III describes the existing environment. Section IV.F provides analyses of low probability, very large oil spills from blowouts and tankers. Appendix A, the Oil-Spill-Risk Analysis, explains and provides information used by the analysts for estimating the probabilities and locations of potential oil spills used in this EIS, including information about the size, location, and distribution of tanker spills.

V.C.4. Significant Cumulative Effects for All Resources

The MMS does not expect any significant cumulative impacts to result from any of the planned activities associated with the exploration and development of oil and gas fields in the Cook Inlet basin. Significance thresholds and significant impacts are defined in Section III.A. In the unlikely event of a large offshore oil spill, some significant adverse impacts could occur to biological resources, sociocultural systems, and Environmental Justice. Those resources that are contacted by an oil spill are expected to recover within two to three generations. These same resources are not expected to be contacted by a subsequent oil spill prior to their recovery. The probability of such an event combined with the seasonal nature of the resources inhabiting the area make it highly unlikely that an oil spill would occur and contact these resources. A resource may be present in the area but may not necessarily be contacted by the oil. An oil spill could affect the availability of a resource, or the resource might be considered tainted and unusable as a food source. The potential for adverse effects to some key resources is of primary concern and warrants continued close attention. Effective mitigation practices should be considered in future projects.

As noted in Section II.B, the MMS does not expect any significant impacts to result from any of the planned activities associated with Alternative I for Sale 191 or any of the alternatives. Potential significant adverse impacts from an unlikely large or very large oil spill biological resources include beach and intertidal essential fish habitat; Steller sea lions and their critical habitat; southwest Alaskan sea otters, Steller's eiders, and marine and coastal birds. Potential significant adverse effects to social systems from an unlikely large or very large oil spill include losses to commercial and sport fisheries from closures, some coastal recreational areas contacted by the spill, subsistence harvests, sociocultural systems, archaeological resources and to environmental justice. Realization of any of these effects depends on the timing, location, size of a spill, and the effectiveness of cleanup efforts.

V.C.5. Summary of Cumulative Effects by Resource

A brief summary of the effects from Alternative I for Sale 191 and the relative contribution of those effects to other past, present, and future activities are presented in Table V-14. The more detailed analyses are found in Sections V.C.5.a through V.C.5.s.

In the following sections, we analyze the potential cumulative effects to individual resources. Each subsection consists of the following:

1. a cumulative analysis,
2. a conclusion and incremental contribution, and
3. a description of transportation effects along the transportation route.

V.C.5.a. Water Quality

V.C.5.a(1) Conclusion

The permitted routine discharges, small oil spills, or possibly a large oil spill associated with the proposed oil and gas development are not expected to cause significant degradation of Cook Inlet water quality. In addition, a large oil spill is unlikely. A very large Trans-Alaska Pipeline System tanker spill in Prince William Sound or inshore Gulf of Alaska could partially enter Cook Inlet. Contamination from such a spill (i.e., the presence of hydrocarbons in amounts greater than 15 parts per billion) would not be expected and, therefore, such a spill would result in oil slicks but not toxic water concentrations of hydrocarbons. Because tanker spills tend to be larger than platform or pipeline spills, backing out of an equivalent tankering by the multiple-sales' production of 140 million barrels of oil would result in a reduction in total amount of projected spillage of oil into the inlet over the no-sale case. The permitted, routine discharges and small oil spills associated with municipal wastewaters, seafood processing, and other oil and gas development also are not expected to cause significant degradation of Cook Inlet water quality.

V.C.5.a(2) Cook Inlet Multiple-Sales' Incremental Contribution

A major spill is not likely to occur from the proposed sale activities, and drilling fluids and produced waters are not anticipated to be discharged during production. The remaining affecting activities—exploration discharges, small spills, and construction activities—would not significantly affect water quality. The hydrodynamic processes in the Cook Inlet Planning Area suggest the water column generally is well mixed, and dilution would reduce the concentration of the substances in the discharges. Degradation processes also act to continuously reduce the concentrations of many substances deliberately or accidentally released into the environment.

Of the permitted discharges, drilling muds and cuttings and produced waters are the most significant discharges associated with offshore operations. The permitted discharges would add substances that may be foreign to or increase the concentration of constituents already present in the water column of Cook Inlet. In general, the added substances may cause sublethal effects in some marine organisms if concentrations are greater than the chronic criteria (for the protection of marine life) and lethal effects if concentrations are greater than acute criteria.

The discharge of drilling muds and cuttings and other discharges associated with exploration drilling are not expected to have any effect on the overall quality of the Cook Inlet water. Within a distance of between 100 and 200 meters from the discharge point, the turbidity caused by suspended-particulate matter in the discharged muds and cuttings is expected to be diluted to levels that are less than the chronic criteria (100-1,000 parts per million) and within the range associated with the variability of naturally occurring suspended-particulate matter concentrations. Mixing in the water column would reduce the toxicity of the drilling muds that already fall into the "practically nontoxic" category to levels that would not be harmful to organisms in the water column. In general, the amounts of additives in the other discharges are expected to be relatively small (from 4-400 or 800 liters/month or 1-100 or 200 gallons/month) and diluted with seawater several hundred to several thousand times before being discharged into the receiving waters. The potential effects in any of the areas where there are permitted discharges would last for about 3-4 months for each exploration well drilled.

Produced waters from a Cook Inlet multiple-sales production platform would likely be injected into underlying formations. Even if discharged, produced waters would not be expected to degrade the quality of Cook Inlet water. The routine other discharges associated with oil production are not expected to cause any overall degradation of Cook Inlet water quality.

Small oil spills, as represented in this analysis by 5- and 160-barrel spills, are not expected to have any degradational effects on the overall water quality of Cook Inlet. The small spills would degrade the water quality for a relatively short period of time, perhaps up to about 10 days, in areas of less than about 50 square kilometers. As noted in Section III.A.4, the concentration of any of the various types of hydrocarbons in the water column generally is quite low or below detection limits. In addition, the total organic compounds in the sediments of Cook Inlet are present in concentrations that indicate an unpolluted environment with no indication of an anthropogenic increase since the start of oil development in Cook Inlet. The hydrocarbons are transitory in the water column and not in evidence in the sediments.

A large oil spill (greater than or equal to 1,000 barrels) would degrade the quality of Cook Inlet water for a period of less than 30 days in an area up to 1,000 square kilometers. The hydrocarbon concentration in the water column above the acute criterion (1,500 parts per billion) would persist less than 3 days. The hydrocarbon concentration may remain greater than the chronic criterion (15 parts per billion) for less than a month.

Construction activities would increase the turbidity in the water column along segments of the 25-mile corridors for up to a few months, but there would be no overall water-quality degradation.

V.C.5.a(3) Past, Current, and Future Cumulative Activities

The cumulative activities most likely to affect water quality in Cook Inlet are (1) the permitted discharges from municipal wastewater-treatment facilities, seafood processors, and the petroleum industry; (2) accidental oil spills; (3) construction activities; (4) and releases from nonpoint sources. As noted in Section III.A.4, the quality of lower Cook Inlet water generally is good (unpolluted), despite past and current activities.

Estimates of the annual suspended solids discharged from the municipalities (2,030 tonnes), refinery (30 tonnes), and drilling muds and cuttings (930 tonnes) are only a fraction of the suspended sediments (36 million tonnes) discharged by the Knik, Matanuska, and Susitna rivers. Estimates of the annual discharge of biological oxygen demand or organic wastes from municipalities (4,270 tonnes), seafood processors (2,520-8,580 tonnes), and produced waters (3,670 tonnes) all are about the same order of magnitude. The amounts of regulated (toxic) metals in municipal discharges, muds and cuttings, and produced waters are only a fraction of that in the river discharge.

Municipal wastewater discharges are estimated to remain at about the present levels for the foreseeable future—about 5-10 years—and are not expected to affect the overall water quality in Cook Inlet. Seafood-processing discharges are estimated to remain at about the present levels for the foreseeable future—about 5-10 years—and are not expected to affect the overall water quality of Cook Inlet.

The Environmental Protection Agency has authorized the Chevron and Tesoro Refineries and the Union Chemical plant under the National Pollutant Discharge Elimination System to discharge processing wastes into Cook Inlet; the Chevron Refinery ceased refining operations in September 1991. The Phillips-Marathon liquefied natural gas plant has a permit from the State of Alaska, Department of Environmental Conservation. These permits provide limits on certain effluent characteristics (see Section III.A.1). Discharges from the petrochemical plants have not and are not expected to degrade the Cook Inlet water quality.

Peak production the four offshore oil fields in upper Cook Inlet occurred in 1970, about 70 million barrels, and subsequently has been declining. Existing permitted discharges have not affected Cook Inlet. Current National Pollutant Discharge Elimination System permits and practice restricts current discharges such that effects on water quality are not anticipated for the Cook Inlet sales for other reasonably foreseeable offshore oil and gas development.

Oil spills have occurred in Cook Inlet, and these spills and the risk of future spills are an issue of major concern. The spill history for Cook Inlet in regard to water quality is summarized in Section III.A.4.a(3)(d) - Oil Spills. Crude tanker, pipeline, dirty ballast discharges, and large product tanker spills have occurred over the last four decades. Based on current oil-industry spill rates, a spill of a thousand barrels or more is not anticipated to occur in Cook Inlet. A very large Trans-Alaska Pipeline System tanker spill in Prince William Sound or inshore Gulf of Alaska could partially enter Cook Inlet. Based on the experience with the *Exxon Valdez* oil spill Inlet (Short and Harris, 1996; Neff and Stubblefield, 1995), hydrocarbon contamination in surface and subsurface waters in the vicinity of the slick would be expected to be less than a tenth of the chronic criterion, less than 1 part per billion total aromatic hydrocarbon, by the time the slick reached Cook Inlet. Thus, the primary effect of such a spill would be physical presence of the slick on the water rather than chemical toxicity.

Construction activities would increase the turbidity in the water column for up to a few months, but there would be no overall water-quality degradation.

V.C.5.a(4) Supporting Evidence for Lack of Effects from Monitoring Studies

Multiple, significant regional monitoring studies in Cook Inlet and downcurrent in Shelikof Strait have been conducted particularly by the MMS and the Cook Inlet Regional Citizens' Advisory Council. The Prince William Sound Regional Citizens' Advisory Council has conducted a long-term monitoring program from Prince William Sound to Shelikof Strait. These studies have examined water, biota, suspended sediments, bottom sediments, and the intertidal shoreline. Numerous parameters have been used to evaluate existing water and sediment quality of Cook Inlet and Shelikof Strait (see Section III.A.4). Some of the parameters and procedures that have been used to evaluate water and sediment quality are:

- measurement of hydrocarbon and trace metal concentrations in sediment
- identification of anthropogenic portion of sediment contaminant loads
- comparison of sediment concentrations to "Effects Levels"; that is, to concentrations below which effects are seldom found
- comparison to local and global concentrations—are they higher or lower than elsewhere?
- time trends in sediment levels—have concentrations or accumulation rates of contaminants increased since oil development started in Cook Inlet?
- comparison of anthropogenic loading to natural source loading
- measurement of acid volatile sulfide levels and simultaneously extractable metals, a technique used to measure metal toxicity in sediments (see Gray, 1999)
- measurement of sediment toxicity (bioassays)
- measurement of Repeater Gene System in sediment as indicator of biologically available contaminants in sediments
- measurement of Repeater Gene System in tissue as an indicator of the presence of contaminants in the organism
- measurement of CYP1A activity, an enzyme indicator that the organism is trying to counteract contaminants
- measurement of hydrocarbons and metals in tissues and organs, indicator of biologically-available contaminant levels
- measurement of physiological condition of biota, indicator of whether environmental stress, including contaminants
- measurement of abundance of hydrocarbon-degrading microorganisms, indicator of oil contamination
- visual (photographic) examination of the sediment/water interface (Sediment Profile Imaging; Arthur D. Little and EVS Environmental Consultants, 1999)
- visual (photographic) "health" inspection of and across the sediment/water interface
- depth of Redox Potential Discontinuity, an indicator of organic contaminant loading
- infaunal stage, indicator of disturbance/disruption
- calculation of the Organism-Sediment Index, a constructed statistic that combines Sediment Profile Imaging-derived parameters into a sediment health index.
- Measurement of naturally occurring radioactive material (NORM) in mussel shells

The general conclusion of these studies is that the existing water and sediment quality of Cook Inlet and Shelikof Strait is good.

V.C.5.a(5) Natural or Nonpoint Sources of Contaminants

Most contaminants in Cook Inlet are derived from natural sources. Nonpoint sources of water pollution also are multiple, diffuse sources of pollution (Environmental Protection Agency, 1990). Primary nonpoint sources of pollution include runoff from urban areas and communities, farms, and mining areas.

V.C.5.a(5)(a) Hydrocarbons

Natural sources of hydrocarbons in Cook Inlet include terrestrial and marine plants and animals, coal, forest fire soot, oil seeps, and eroded (petroleum) source rock. Most of the hydrocarbons detected in the waters, suspended-particulate matter, seafloor sediments, and intertidal biota of Cook Inlet in studies since oil development started in Cook Inlet are of recent biogenic origin (Shaw, 1981; Katz and Cline, 1981; Kaplan et al., 1980; Venkatesan and Kaplan, 1982). Pyrogenic polycyclic aromatic hydrocarbons (formed by incomplete burning) enter Cook Inlet through deposition of soot from combustion of fuel and natural organic matter, particularly from forest fires (Kaplan et al., 1980; Venkatesan and Kaplan, 1982; Boehm, 1998). Atmospheric transport can carry combustion polycyclic aromatic hydrocarbons long distances before deposition; thus, their presence are expected with or without local sources. Pyrogenic polycyclic aromatic hydrocarbons also enter the marine environment when creosote or coal tar products are used to protect wood pilings and docks (Page et al., 1993).

V.C.5.a(5)(a)1) Rivers

The streams and rivers draining into Cook Inlet carry hydrocarbons. Part of these carbon compounds are biogenic, and part comes from the erosion of sedimentary rocks that may contain hydrocarbon compounds, from coal deposits are found throughout the Cook Inlet region, and from peat (Shaw and Wiggs, 1980; Page et al., 1995; Short et al., 1999, 2000; Boehm et al., 2000; Boehm 2001a; Lees et al., 2002). In all sedimentary rocks, about 3% of the organic matter is converted to hydrocarbons with 15 or more carbon atoms and practically all shales and carbonate rocks contain liquid hydrocarbons that are comparable to reservoir oils (Hunt, 1979). Coal contains substances derived from plant resins, waxes, and fats and oils and includes aliphatic and aromatic compounds (Schobert, 1990). Peat from Cook Inlet and elsewhere contains significant quantities of specific polycyclic aromatic hydrocarbons, naphthalenes, and perylene (Lees et al., 2002; Boehm, 2001b; Steinhauer and Boehm, 1992). It is not clear why naphthalenes accumulate in peat, but perylene accumulates as a natural degradation product of organic matter decomposition. The amount of carbon streams and rivers transport into Cook Inlet is estimated to be at least 35,000 tonnes per year. This is a low-range estimate, because it is based on the amount of dissolved carbon in the Susitna River (at Gold Creek) in June, July, and August of 1985 (Still et al., 1985); this amount is assumed to be 4 parts per million.

V.C.5.a(5)(a)2) Coal

Cook Inlet is part of the Cook Inlet-Susitna coal province that includes the Susitna and Matanuska Valleys, the western side of the Kenai Peninsula, and Cook Inlet north of Augustine Island (State of Alaska, Dept. of Natural Resources, 1990). Coal particles are transported to the Cook Inlet marine environment as the result of local erosion, river transport, and possibly coastal marine transport from Gulf of Alaska sources (Lees et al., 2002; Short and Heintz, 1998; Short et al., 1999). Coal hydrocarbons have been found in both Cook Inlet sediments and biota (Shaw and Wiggs, 1980; Boehm, 2001a; Lees et al., 2002).

V.C.5.a(5)(a)3) Seeps

Oil seeps also are a source of hydrocarbons to Cook Inlet. The Gulf of Alaska has high potential for oil seepage and Cook Inlet has medium potential for oil seepage (Becker and Manen, 1988). Seeps have been identified upcurrent to Cook Inlet in the Katalla area, in the Cook Inlet watershed, and on the Alaska Peninsula (Blasko, 1976; Becker and Manen, 1988; Page et al., 1995). Becker and Manen identified eight seeps in the Cook Inlet and Shelikof Strait region: Iniskin Peninsula (Oil Bay), Chinitna Bay, Tyonek and Mouth of the Little Susitna River, Anchorage near Knik Arm (no longer active), Puale Bay (Coal Bay, Wide Bay, Oil Creek), Shelikof Strait, Douglas River, and Bruin Bay.

V.C.5.a(5)(a)4) Source Rock

Eroded petroleum source rock also may be a significant natural source of hydrocarbons in the Gulf of Alaska (Boehm et al., 2000) upcurrent and into Cook Inlet.

V.C.5.a(5)(a)5) Vessels

For this analysis, oil pollution from commercial and recreational vessels is considered to be a nonpoint source of pollution because of the dispersed character of the sources. The *Oil Spill Intelligence Report* (2001b) found that nontank vessels and other unregulated operators had tenfold higher occurrence rates and fiftyfold higher volume spillage than oil industry and other regulated operators in Alaskan waters. Between 1965 and 1980, there were a reported 269 nonpetroleum-industry oil spills; the reported amount of oil spilled for 206 of the spills was 22,746 barrels—no volume was reported for 63 spills (State of Alaska, Oil and Gas Conservation Commission, 1981). More recent data have not been compiled and published.

This spillage category includes sinking of nontank vessels such as tugboats (Associated Press, 1989), fishing vessels (Oil Spill Intelligence Report, 2001a), and spills from refined product vessels. Section III.A.4.a(3)(d)3 lists four refined product (diesel, JP-4, and Jet A) spills of over a thousand barrels in Cook Inlet since 1966. Oily ballast water discharges have occurred (Federal Water Pollution Control Administration, 1970) and are still occurring in the Gulf of Alaska, including Cook Inlet. Significant enforcement actions have recently had to be taken against both cargo fleets (*Oil Spill Intelligence Report*, 2002) and cruise ship fleets (Henderson, 1999; *Golob's Oil Pollution Bulletin*, 1998) operating in the Gulf of Alaska for deliberately and illegally discharging oily waste.

Oil sheens observed on the water surface are another source of information about vessel oil spills. During surveillance flights in Prince William Sound and the Gulf of Alaska between September 1989 and September 1990, 260 sheens observed were attributed to sources other than *Exxon Valdez*; that is, fishing boats, recreational boats, and cruise ships (Taft, Egging, and Kuhn, 1995); the number of non-*Exxon Valdez* slicks was about 31% of the total number of slicks observed. The estimated amount of oil in these sheens totaled about 8,100 liters (about 193 barrels) and ranged from less than 1 to 6,000 liters; the largest spill consisted of diesel fuel from a cruise vessel.

Small oil spills (less than 1,000 barrels) from commercial and recreational vessels are not expected to affect the overall quality of Cook Inlet water. However, hydrocarbons from a large (at least 1,000 barrels) commercial- or recreational-vessel oil spill could temporarily degrade the overall quality of Cook Inlet water. These effects are the same as described for small and large spills that might occur as a result of activities associated with the Cook Inlet multiple sales (see Section IV.B.1.a).

V.C.5.a(5)(b) Metals

River and stream discharges are the primary source of metal contaminants to Cook Inlet. The suspended particulate matter discharged by the rivers into Cook Inlet is derived from the erosion of a variety of igneous, sedimentary, and metamorphic rocks surrounding the inlet. Within the statistical limits of the measurements, the samples from lower Cook Inlet have very nearly the same major elemental composition as do the samples from the rivers. However, the composition of suspended particulate matter in the southeastern part of Cook Inlet (the outer part of Kachemak Bay and the Kennedy and Stevenson entrances) indicates these particles principally came from the Copper River (Feely et al., 1981) and were transported westward by the Alaska Coastal Current. This is consistent with the circulation of Alaska Coastal Current water into Cook Inlet discussed in Section III.A.3.

V.C.5.a(6) Summary

Cook Inlet Sales 191 and 199 are estimated to contribute about 36% of the future offshore spill risk. Because oil produced from these sales would substitute for Trans-Alaska Pipeline System crude that would otherwise be tankered into Cook Inlet and refined, the incremental spill risk from the multiple sales in terms of number of spills is only 13%. Because tanker spills tend to be larger than platform or pipeline spills, the backing out of tankering equivalent to the multiple sale production of 140 million barrels of oil would result in a net reduction in total amount of projected spillage of oil into the inlet.

Cook Inlet Sales 191 and 199 would contribute a negligible portion of other contaminant loading. Despite the current and past level of oil and other industrial activity in Cook Inlet, the water quality of lower Cook Inlet generally is good. Cook Inlet is a relatively large tidal estuary with a sizable tidal range. The turbulence associated with tidal currents mainly and the winds results in the vertical mixing of the waters. A relatively large volume of waters and a large variety of naturally occurring inorganic, mainly, and organic substances are transported into Cook Inlet by the streams and rivers and by currents from the Gulf of Alaska; the amounts of the individual substances discharged into the inlet appears to be quite variable. Substances transported into Cook Inlet that remain in suspension or dissolved in the water column are dispersed by the current regime.

A variety of manmade substances are routinely discharged into Cook Inlet. The major discharges are from municipalities bordering Cook Inlet, the oil and gas industry, and seafood processors. The quantities of manmade substances discharged into Cook Inlet generally are less than discharged by the streams and rivers. For some of the manmade substances, the amounts discharged may be within the range associated with the natural variability of stream and river discharges. In addition to the routine discharges, there have been a number of accidental spills of a variety of substances, including crude oil and refined petroleum products. Hydrocarbons are found throughout the marine environment, but the concentrations generally are low and of biogenic origin—mainly derived from terrestrial plants. The low concentrations of hydrocarbons in Cook Inlet are similar to concentrations found in other unpolluted coastal areas. The amount of total organic carbon in the sediments, where contaminants could accumulate, is low and indicates an environment that generally is uncontaminated.

V.C.5.b. Air Quality

Air-quality regulations and procedures are discussed in Section IV.B.1.b. That discussion also describes the methodology used to model the air-quality effects associated with this proposed lease sale. The Environmental Protection Agency-approved Offshore and Coastal Dispersion model was used to calculate the effects of pollutant emissions due to the proposal on onshore air quality. Because the Class I Prevention of Significant Deterioration areas allow for the least amount of degradation, the modeling scenario (that is, source location) chosen for this analysis is the one that results in the maximum-potential effect to the air quality of the designated national wilderness area of the Tuxedni National Wildlife Refuge, the only Class I area adjacent to the Cook Inlet multiple-sale proposal area. The maximum-potential effect at any location in the Class II area would be the same. In all likelihood, effects to the Tuxedni National Wilderness Area would be lower than those calculated by the model.

For a more detailed discussion of the potential effects of air pollution, please see Section IV.B.1.b.

V.C.5.b(1) Conclusion

The effects associated with the cumulative analysis would be essentially the same, qualitatively, as those discussed for the Alternative I Proposal. We expect the effects on onshore air quality from cumulative analysis emissions to be 20.4% of the maximum allowable Prevention of Significant Deterioration Class I increments. Only the Tuxedni National Wilderness Area is designated Class I, with the remaining area in and adjacent to the sale area designated Class II. The potential effects in the Class II areas would be much less than the percentage of the Class I increments. These effects would not make the concentrations of criteria pollutants in the onshore ambient air approach the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected. Principally because of the distance of emissions from land, the other effects of air-pollutant concentrations at the shore from exploration, development, and production activities, or accidental emissions would not be sufficient to harm vegetation.

V.C.5.b(2) Incremental Contribution to Cumulative Effects from Cook Inlet OCS Sale 191

For purposes of analysis, this cumulative analysis includes the activities as described for the Proposal for Cook Inlet Sales 191 and 199. Existing air quality is well within the Federal and State standards; we expected no significant change. Factors potentially affecting air quality would be (a) existing and projected oil and gas operations onshore and (b) the near offshore and transport vessels (liquefied natural gas, oil, and coal) using shipping lanes through the proposed sale area. All other oil and gas operations are well beyond the area of potential cumulative effect from this Proposal. Vessel traffic also would not contribute to the air-quality effects assessed for the Proposed Action. Potential air-quality affects associated with the proposed Cook Inlet lease sales were estimated using the Offshore and Coastal Dispersion Model (Herkhof, 2002) (see Appendix H - Air Quality Modeling). Peak-year emissions from exploration would be from drilling two exploration or delineation wells from one rig. Peak-year emissions from development would include platform and pipeline installation and the drilling of 16 production wells from one rig. Peak-year production emissions would result from operations producing 18.3 million barrels of oil and 18.4 billion cubic feet of gas and transportation of those products. Estimated uncontrolled-pollutant emissions for the peak-exploration, peak-development, and peak-production years' activities related to the proposed sales should be well within National Ambient Air Quality Standards and Prevention of Significant Deterioration limits. Because the Class I Prevention of Significant Deterioration areas allow for the least amount of degradation, modeling for this Proposal assumed maximum effect to the air quality of the designated national wilderness area of the Tuxedni National Wildlife Refuge, the only Class I area adjacent to the proposed sale area. Under Federal and State of Alaska Prevention of Significant Deterioration regulations, a Prevention of Significant Deterioration review would be required because the estimated annual uncontrolled nitrogen oxide emissions for the peak-development year would exceed 250 tons per year. The lessee would be required to control pollutant emissions through application of Best Available Control Technology to emissions sources.

The highest predicted annual average nitrogen dioxide concentration in the Tuxedni National Wilderness Area was 0.27 micrograms per cubic meter. This is well within the maximum allowable Prevention of Significant Deterioration Class I increment of 2.5 micrograms per cubic meter. The highest annual, 24-hour, and 3-hour average sulfur dioxide concentrations were 0.02, 0.58, and 2.7 micrograms per cubic meter, respectively. The corresponding maximum allowable Prevention of Significant Deterioration Class I increments are 2, 5, and 25 micrograms per cubic meter. The highest annual and 24-hour average PM_{10} concentrations were 0.02 and 0.51 micrograms per cubic meter. The corresponding maximum allowable Prevention of Significant Deterioration Class I increments are 4 and 8 micrograms per cubic meter. The highest annual nitrogen dioxide concentrations, highest 24-hour and 3-hour average sulfur dioxide concentrations, and highest 24-hour average PM_{10} concentrations exceed the significance levels prescribed by the Federal Land Manager for Prevention of Significant Deterioration Class I areas. The Class I significance levels are 0.03 micrograms per cubic meter for the annual average nitrogen dioxide, 0.07 micrograms per cubic meter for the maximum 24-hour average sulfur dioxide, 0.48 micrograms per cubic meter for the maximum 3-hour average sulfur dioxide, and 0.27 micrograms per cubic meter for the maximum 24-hour average PM_{10}.

Because we estimate that Sale 191 would contribute about 7.0% of Cook Inlet past, present, and reasonably foreseeable oil resources (Table V-9), it is reasonable to estimate that it also might contribute about 7.0% of oil-related pollutant emissions. (The actual pollutant emissions probably would be less than 7.0% of cumulative regional emissions, because regulatory and technological controls on such emissions are stricter now than they were at the times of much of the past production.)

We expect no increase in refinery throughput at Nikiski, Alaska, because we assume that the Cook Inlet multiple-sales crude oil would displace North Slope oil that is currently received from the Valdez terminal. Therefore, we expect no change in refinery emissions. Vessel traffic also would not contribute to the air-quality effects assessed for the Proposed Action (as described in Section IV.B.1.b).

V.C.5.b(3) Cumulative Effects from Other Projects and Activities (Past, Present, and Future)

Existing emission sources in the Cook Inlet area include oil-production activities in State of Alaska waters, onshore petroleum processing and refining, onshore oil and gas production, marine terminals, and commercial shipping. Oil production in State waters is relatively small and is declining. Any potential future development in State waters probably will be small. Overall, we expect no significant future changes to emissions in the area. Existing air quality is well within the Federal and State standards; we expected no significant change. Factors potentially affecting air quality would be existing and projected oil and gas operations onshore and the near offshore and transport vessels (liquefied natural gas, oil, and coal) using shipping lanes through the proposed sale area. All other oil and gas operations are well beyond the area of potential cumulative effects from this Proposal.

V.C.5.b(4) Cumulative Effects of Oil Spills and Large Gas Releases from OCS and State of Alaska Oil and Gas Activities

Oil spills are one accidental source of gaseous emissions. The most likely number of one or more oil spills of 1,000 barrels or more occurring due to the proposed Sales 191 and 199 is zero. Smaller spills (less than 1,000 barrels) would occur more frequently than larger spills. The probability of one or more spills occurring is related to the oil-spill rate and amount of oil production. The volatile organic compounds released from oil spills would be scattered in space and time.

Gas or oil blowouts may catch fire. In addition, in situ burning is a preferred technique for cleanup and disposal of spilled oil in oil-spill-contingency plans. For catastrophic oil blowouts, in situ burning may be the only effective technique for spill control. For any given fire, we expect that any smoke reaching the shore would be dispersed quickly (usually within 1 day) and be limited to a local area, resulting in a minimal effect on air quality.

The cumulative effects on air quality of past, present, and anticipated future oil spills and large gas releases are and should remain small, localized, and temporary.

V.C.5.b(5) Transportation Effects

Cumulative effects on air quality in the Cook Inlet area because of transportation activities have been low. Routine transportation-related effects on air quality occur from vessel emissions (and locally onshore from vehicle emissions). The 8-hour average concentration of carbon monoxide in Anchorage (nearly all from motor vehicles) violated the ambient standard once each in 1996 and in 2001, but not since then. We anticipate no significant transportation-related effects on air quality from vessels or motor vehicles. Some temporary adverse effects on air quality have occurred because of transportation-related oil spills such as *Glacier Bay* and *Exxon Valdez*, but those effects on air quality were of very short duration. Normal atmospheric circulation disperses the volatile organic compounds released from spilled oil, usually within about 1 day.

Transportation effects to air quality along the transportation route from Cook Inlet to U.S. west coast ports (the destinations we expect for most of the oil) would consist of routine emissions from vessels and any accidental emissions related to very low probability oil spills. Emissions from both of these categories should be insignificant. We expect that any future adverse effects on air quality because of transportation activities, both within Cook Inlet and along the transportation route, would be very localized and temporary.

V.C.5.c. Lower Trophic-Level Organisms

This section examines the cumulative effects on these organisms due to proposed Sales 191 and 199 plus other past, ongoing, and planned projects in Cook Inlet.

V.C.5.c(1) Conclusions

The overall cumulative effect of permitted discharges and construction on lower trophic-level organisms likely would be negligible or immeasurable. Small spills and the cleanup responses to them probably would affect a few coastal habitats, including lower trophic-level organisms. In the few affected areas, populations of some intertidal organisms probably would be depressed measurably for about a year, and small amounts of oil would persist in shoreline sediments for more than a decade. An unlikely large oil spill could contaminate up to 39 kilometers of shoreline, most likely in southwestern Cook Inlet or western Shelikof Strait. In the affected area, populations of some intertidal organisms would be depressed measurably for about a year, and small amounts of oil would persist in shoreline sediments for more than a decade.

V.C.5.c(2) Cook Inlet Sales 191 and 199 Incremental Contribution

The assessment of Sales 191 and 199 concluded partly that routine, anticipated activities during exploration, development, and production as a result of Sale 191 likely would not have measurable effects on local populations of lower trophic-level organisms (Section IV.B.1.c). Similar impacts as a result of Sale 199 would cause effects of the same low magnitude about 2 years later. Section V.C.5 on water quality concludes similarly that exploratory discharges, small spills, and construction activities from the Sales 191 and 199 would not significantly affect that resource.

A large spill (greater than 1,000 barrels) would be very unlikely with Sales 191 and 199, but one was assumed to occur for the sake of the assessment. We conclude that such a spill and the likely responses to it would affect lower trophic-level organisms (Section IV.B.1.c). A 1,500-barrel production platform spill or a 4,600-barrel pipeline spill probably would contaminate up to 39 kilometers of shoreline, most likely in southwestern Cook Inlet or western Shelikof Strait. In the affected area, populations of some intertidal organisms would be depressed measurably for about a year, and small amounts of oil would persist in shoreline sediments for more than a decade.

V.C.5.c(3) Past, Current, and Future Cumulative Activities

The amount of permitted discharges and construction would not be much greater than for Sales 191 and 199 alone, so the effect on lower trophic-level organisms probably would be negligible or immeasurable. The cumulative effect of oil spills probably would be greater. Small oil spills have occurred in Cook Inlet, and these spills and the risk of future spills are an issue of major concern. The reported amount of oil spilled in Cook Inlet waters from 1965 through 1975 was 20,636 barrels; between 1976 and the end of 1979, an additional 9,534 barrels were reported spilled (State of Alaska, Oil and Gas Conservation Commission, 1981). Additional spills such as these probably would drift to shore and affect some coastal habitat. The populations of some intertidal organisms in small areas probably would be depressed measurably for about a year, and small amounts of oil would persist in shoreline sediments for more than a decade.

The activities in Cook Inlet that most likely would cause a large spill are shipping and oil production, such as occurs in State waters of upper Cook Inlet. The estimated number of tanker spills due to past, present, and reasonably foreseeable activities in Cook Inlet is only 0.11 (Table V-10). The mean number of exploration and development spills increases from 0.21 (for Sales 191 and 199) to 0.58 for the cumulative case, which means that the likelihood of such a spill is still less than one spill.

There is an extremely small likelihood that a large spill outside of Cook Inlet, such as the *Exxon Valdez* oil spill, would drift into the inlet and/or Shelikof Strait. The primary effect of such a spill would be the physical presence of the slick that drifted onto the inlet shoreline. Such shoreline contamination and the likely responses to it could affect a small amount of the coastal habitats in Cook Inlet and Shelikof Strait for more than a decade.

In summary, the overall cumulative effect of permitted discharges and construction on lower trophic-level organisms probably would be negligible or immeasurable. Small spills and the probable responses to them might affect some coastal habitats, including the intertidal organisms. In the affected area, populations of some intertidal organisms probably would be depressed measurably for about a year, and small amounts of oil could persist in shoreline sediments for more than a decade.

V.C.5.d. Fisheries Resources

This section considers the cumulative effects of other past, ongoing, and planned projects in Cook Inlet, as well as the Proposed Action. Fisheries resources could be affected by drilling discharges, offshore construction activities, seismic surveys, oil spills, commercial fishing, commercial-logging operations, and Native subsistence and sportfishing. This analysis considers the potential effects of these events and activities on fish resources.

V.C.5.d(1) Conclusion

The estimated effects of an unlikely large oil spill would not be measurable at the population level. The overall cumulative effect on fisheries resources may include reduced stocks of some fisheries resources (sockeye, coho, and chinook salmon, some semidemersal fish such as pollock, and some shellfish), primarily due to the potential for overharvest of these stocks by commercial-fishing activities. This effect could persist for several generations or longer. Proposed Sale 191 is not expected to contribute measurably to these adverse effects. While some individual fishes may be disturbed, injured, or killed, effects measurable at the population level are not likely.

V.C.5.d(2) Drilling Discharges, Offshore Construction Activities, and Seismic Surveys

Although infrequent, drilling discharges, offshore construction, and seismic surveys have been ongoing for many years in the Cook Inlet region with no known measurable effect on fish populations. Demersal fishes can be disturbed and displaced from the immediate vicinity of drilling discharges, but these effects are typically limited to within 100 meters of the discharge and would affect only small numbers of fishes. Offshore construction could temporarily disturb and/or displace fisheries resources. However, any disturbance or displacement should be short term (hours to days), and may be limited to only the time of construction and shortly thereafter. Though seismic-surveys may damage the eggs and larvae of some fishes, this injury would be limited to only a meter or two from the airgun-discharge ports. Drilling discharges, offshore construction activities, and seismic surveys associated with former or ongoing activities have had no known measurable effects on fish populations to date. For this reason, the relatively small contribution made by Cook Inlet Sales 191 and 199 to discharges, offshore construction activities, and seismic surveys is expected to have no known measurable additive effect on fish resources.

V.C.5.d(3) Effects of Oil Spills from OCS and State of Alaska Oil and Gas Activities

The mean number of offshore spills estimated for the cumulative analysis is 0.58, although we estimate 0.21 for Alternative I. The most likely number of spills from all past, present, and reasonably foreseeable future activities is zero. The estimated number of tanker spills is 0.11 for past, present, and reasonably foreseeable oil activities. The most likely number of tanker spills for Cook Inlet Sales 191 and 199 is zero (Table V-10). Potential effects of a 1,500- to 4,600-barrel spill are assessed in Section IV.B.1.d.

V.C.5.d(4) Effects of Commercial Fishing on Fisheries Resources

The activity most likely to affect fisheries resources in the cumulative case would be that of commercial fishing. There are seine, driftnet, and setnet fisheries for salmonids throughout the Cook Inlet area and the adjacent waters of Kodiak/Shelikof Strait. Some of these fisheries (i.e., setnet and nearshore seine) can target specific fish species returning to their natal stream or river. However, because salmonids can and will transit along the nearshore areas in their return to natal rivers, even the setnet fisheries harvest mixed stocks of fish and multiple fish species. In addition, many of the commercial-fishing methods take place in pelagic waters, where it is even less certain which stock is being harvested in the mixed-stock fishery at a given time.

In recent years, so-called “intercept” fisheries have developed to harvest sockeye salmon in otherwise nontraditional fishing grounds for the targeted species (western side Kodiak fishing for Cook Inlet-destined sockeye and lower Cook Inlet fishing for upper Cook Inlet-destined fish). These intercept fisheries may reduce the amount of fish available for harvest at terminal commercial and sport fisheries. It is possible that intercept fisheries contribute to reduced fish harvests in upper Cook Inlet and lowered king and sockeye escapements in some streams in the Susitna River drainage. If management of these resources does not adequately address the mixed-stock and intercept fisheries in Cook Inlet, certain finfish resources (sockeye, coho, and chinook salmon) could be overharvested during the life of the Proposal. A substantial trawl fishery exists in the lower Cook Inlet and Kodiak/Shelikof Strait areas for semidemersal fish (groundfish, particularly pollock). Catches have declined steadily since the mid 1960’s and 1970’s. Although this fishery is managed closely by the North Pacific Fishery Management Council, there remains the possibility of overfishing during the life of the Proposal. Herring fisheries in Cook Inlet also have declined in recent years and were closed due to low abundances in 1998. Shellfish stocks also have been declining in Cook Inlet and the Kodiak/Shelikof Strait area, and many have been closed for a number of years in these waters.

While there is no proof that the many declines in fishery stocks seen in the past 20 years have been due to commercial fishing, it appears that commercial fishing has been one of the most likely contributors. Other possibilities suggested include increased predation, fluctuations in natural population cycles, unfavorable ocean and/or river conditions, diseases, increased sport and subsistence fishing, and/or a combination of all of the above. Any one of these possibilities (or any combination thereof) also could be a major contributor to the declines in fish resources. However, none of them are as easy to collect long-term data on, and thereby identify as a contributor (or noncontributor) to the declines as is commercial fishing. For this reason, there is a great wealth of information about commercial harvests over the years but little to no information as to how these harvests have affected natural population cycles over the long term. Nevertheless, based primarily on catch records and stock estimates, commercial fishing appears to be at least one of the most likely contributors to the decline of some fish resources.

V.C.5.d(5) Effects of Logging on Fisheries Resources

Within the Cook Inlet region, timber harvests occur on the Kenai Peninsula and Afognak and adjacent islands. Timber harvest can affect local populations of finfishes by reductions in local invertebrate prey populations due to benthic bark accumulations at log-transfer facilities. The log-transfer facilities can reduce invertebrate populations dramatically within the local area of the facility but usually only on the order of a few acres. Effects from log-transfer facilities are expected to be minimal for finfishes in the cumulative case.

V.C.5.d(6) Effects of Subsistence and Sportfishing on Fisheries Resources

Certain finfishes are harvested by Native Alaskans for subsistence use. These fish resources include all species of salmon, eulachon, cod, and other fish species. Details on subsistence fishing can be found in Section IV.B.1.j - Subsistence-Harvest Patterns. Due to the relatively small number of fish resources harvested for subsistence purposes, this activity is not likely to have a measurable cumulative effect on fishery resources.

Sport and commercial fishing in Alaska are managed primarily by the Alaska Department of Fish and Game, The North Pacific Management Council, and the International Pacific Halibut Commission. Seasons and harvest levels are set in much the same way for each type of fishing, although allocations and seasons differ greatly. While there has been a recent political trend in Alaska toward the sportfishing industry, allocations for sportfishing typically are only a fraction of that allocated to the commercial-fishing industry. For this reason, sport harvests generally are considered to have much less of an effect on fish populations than those of the commercial-fishing industry. Hence, while it contributes to declines in the number of available fish, sport fishing is not likely to have a measurable cumulative effect on the fish resources of Cook Inlet.

Add Cumulative impacts of developing terrestrial lands and offshore oil and gas development of state resources.

V.C.5.e. Essential Fish Habitat

This section describes the cumulative effects of this lease sale, other oil and gas development and general human development, and petroleum transportation on essential fish habitat in the lease area. In Essential Fish Habitat sections of this EIS, the National Environmental Policy Act term "impact" means the same thing as and is interchangeable with the Sustainable Fisheries Act term "adverse effect."

For the convenience of the reader, the general conclusions are summarized at the beginning before the extended discussion and evaluation.

V.C.5.e(1) Conclusion and Incremental Contribution

The primary cumulative effects of Sale 191 would be a small incremental increase in human, industrial, and commercial-fishing effects of development in Cook Inlet. The input of petroleum hydrocarbons to essential fish habitats from the use of the oil (primarily as fuel) is estimated to be approximately eight times greater than the effects of producing and transporting the crude oil. Commercial fishing also removes up to 10% of the adult populations of important forage fish, and bottom trawling causes an order of magnitude more damage to bottom habitats than the estimated disturbance from pipeline construction. The cumulative impacts of all activities also include those from both local and global human activities that contribute to global climate change.

The adverse impacts of the proposed sale on essential fish habitat are considered low. Similarly, the combined effects of this sale, along with other oil development in Cook Inlet, are considered low. However, as discussed in Section IV.B.1.e, in the unlikely event that a large oil spill (1,500-4,600 barrels) occurs, the beach and intertidal fish habitats could be affected. Oil could remain in these areas or prey could be impacted for more than a decade, which is three or more generations for some species and, as such, would be a significant cumulative effect. However, such habitat degradation likely would be limited to a very small proportion of habitat, and the habitat of only small populations or subpopulations would be affected.

The ecosystem that constitutes essential fish habitat is complex. There is considerable uncertainty about the extent to which small, sublethal effects from cumulative human development, such as fishing, chronic urban contamination, and numerous small fuel spills in Cook Inlet, can change ecologically complex essential fish habitats. Furthermore, for essential fish habitat both locally in Cook Inlet and globally, the cumulative effects depend in part on whether the changes occur at a crucial time period or in a critical location.

Synergistic effects, such as the thousandfold increased toxicity of aqueous oil in the presence of sunlight, have been demonstrated for zooplankton. The synergistic effects of sunlight also have been demonstrated in herring larvae.

V.C.5.e(2) Incremental Contribution to Cumulative Effects from Cook Inlet Sales

These lease sales are predicted to contribute the following:
- 7% of oil development activities in Cook Inlet,
- 26% of the oil-spill risk in Cook Inlet, and
- 14% decrease in risk of a tanker oil spill because of decreased oil-tanker traffic from Valdez.

Thus, 7% of oil industry seismic activities on the essential fish habitat of Cook Inlet in the form of temporary degradation of habitat (disturbance of the habitat that causes fish to move out of the habitat) by the noise level (decibel) of vessels and seismic gun explosions are predicted from this sale. Fish prey species may also be temporarily affected. Additionally, 7% of the oil development seismic sound waves in the frequencies (hertz) that potentially may cause damage to fish sensory organs are expected from cumulative in Cook Inlet. The area directly covered by seismic surveys would be approximately 900 square miles.

The 50 miles of offshore oil pipeline to be constructed under this scenario would increase the present total of 134 miles of offshore pipeline by 37%. The expected cumulative effects of pipeline construction are the temporary (during actual construction) loss of approximately 50 acres of demersal fish habitat and temporary (2-3 hours) turbidity plumes over approximately 270 square kilometers of essential fish habitat.

V.C.5.e(3) Cumulative Effects from Other Projects and Activities

The cumulative activities identified as most likely to affect essential fish habitat in Cook Inlet are, from most likely to least likely: (1) commercial fisheries, (2) global warming, (3) nonpoint pollution sources resulting from anthropogenic sources in the Cook Inlet region, (4) oil spills from production and transportation of crude oil, and (5) permitted discharges such as from municipal and seafood processing.

To evaluate the cumulative effect of these five human activities on essential fish habitat, natural conditions of Cook Inlet waters need to be taken as a baseline. As described earlier in Section V.C.5.a - Water

Quality, despite the current and past level of oil and other industrial activity in Cook Inlet, the water quality of lower Cook Inlet generally is good. Cook Inlet is a relatively large tidal estuary with a sizable tidal range. A relatively large volume of water is transported into Cook Inlet by the streams and rivers and by currents from the Gulf of Alaska. Tidal currents and winds mix the waters. Many of the substances discharged into the waters remain suspended or dissolved in the water column and are dispersed by the current regime.

A large variety of those substances in the water column are from naturally occurring organic and inorganic substances. A surprisingly large portion of petroleum inputs into North American waters is from natural seeps. The National Research Council (1999) estimates that of all the oil that reaches marine waters worldwide, 45% is from natural seeps; however, of oil that reaches U.S. marine waters, 60% is from natural seeps. Because Cook Inlet has at least eight natural seeps, it is likely to be typical of U.S. waters in this respect.

V.C.5.e(3)(a) Commercial Fisheries

As discussed in the cumulative-effects sections on fisheries and commercial fisheries (Sections V.C.5.d and V.C.5.k), the activity most likely to affect fisheries resources in the cumulative case would be commercial fishing. Based primarily on catch records and stock estimates, commercial fishing appears to be at least one of the most likely contributors to the decline of some fish resources. If fisheries in Cook Inlet and the Gulf of Alaska are not adequately managed, certain fish resources could be overharvested during the life of the Proposal.

Much of the following summary of the general effects of commercial fishing on marine ecosystems is taken directly from a review by Jennings and Kaiser (1998). Fishing is the most widespread human exploitative activity in the marine environment. An estimated 20% or more of primary production is required to sustain fisheries in many intensively fished coastal ecosystems. Fishing has significant direct and indirect effects on habitat, and on the diversity, structure, and productivity of benthic communities. The proportion of fish caught in many fisheries leaves little latitude for recruitment failure, and unwanted recruitment failure and unwanted bycatch often form a relatively large proportion of the total catch.

Fishing has a number of direct effects on marine ecosystems, because it is responsible for increasing the mortality of target and bycatch species and disturbing marine habitats. The direct effects of fishing have many indirect implications for other species. Thus, fishers may remove some of the prey that piscivorous (fish-eating) fishes, birds, and mammals otherwise would consume, or may remove predators that otherwise would control prey populations. The portion of the total catch that is discarded, dead, or dying, either because it is illegal to land or because there is little or no economic gain associated with sorting or retaining it, constitutes approximately 27% of global fish catches.

The effects of fishing on habitats are often large-scale ramifications of the cumulative effects on many individual plants and invertebrates, because habitats such as kelp forests, coral reefs, or bryozoan beds are formed by living organisms. (These living habitats are identified as Habitats Areas of Particular Concern and addressed at the end of Section IV.B.1.e(4).) Many types of fishing gear have direct effects on habitat structure. However, indirect effects occur when fishing initiates shifts in the relationships between those organisms responsible for habitat development and degradation. The indirect effects of fishing on nontarget fishes and invertebrates may lead to changes in community structure and habitat type.

Physical disturbance of the substratum results from direct contact with fishing gear and the turbulent resuspension of surface sediments. The studies reviewed clearly illustrate the two main effects of mobile gears on epifaunal communities:

1. modification of substrata (shell debris, boulders, mud veneers) and
2. removal of biogenic taxa, and a consequent decline in the abundance of fauna associated with them.

The loss of biogenic species not only reduces the supply of important prey species but also increases predation risk of juvenile commercial species, thereby lowering subsequent recruitment to the adult stocks.

Fishing affects the diversity of fishes and other species, and there is increasing concern that, together with pollution, fishing is a major cause of diversity loss in the aquatic ecosystems. Fishing, often in conjunction with environmental change, has reduced the abundance of many fish populations and driven others to economic extinction. Many fishing techniques have direct effects on marine habitats and benthic fauna, but these effects occur against a background of natural disturbance and, as a result, the significance of fishing effects increased markedly with depth and environmental stability.

Low levels of fishing effort may have significant effects on the diversity and structure of fish communities and the greatest effects and are most commonly observed when a previously unfished area is fished for the first time. However, once an ecosystem has been fished, diversity, structure, and fish production tend to remain relatively stable across a wide range of fishing intensities, until extreme change occurs. Many predatory fishes exhibit the capacity to vary their diets as a result of environmental fluctuations or over the course of the growth and development of an individual to maturity. Some species also are capable of resorting to cannibalism. As a result, fluctuations in the abundance of one or two prey species rarely have a marked effect on populations of predatory fishes. Only when fishing effort is so high that numerous species are depleted, or when fishers resort to fishing techniques that destroy habitat, will further changes in community structure become apparent. However, the reproductive success and abundance of birds and marine mammals that rely on relatively few prey species is tightly coupled with fluctuations in the abundance of their preferred prey. For these birds and mammals, it is reasonable to state that they are indirectly affected by fishing, if fishing is the cause of changes in their prey populations.

If we apply the above ideas from the Jennings and Kaiser review to Cook Inlet, there are some similarities. Forage fish, particularly pollock and possibly herring, are known to be a critical essential fish habitat and critical ecological component in Cook Inlet as a food to many different commercial-fish species (and life-cycle stages), as a predator on many other species and life-cycle stages, and a critical pathway in the ecosystem. The critical ecosystem component of pollock also is discussed in Section IV.B.1.e - Essential Fish Habitat and Section IV.B.1.f - Endangered and Threatened Species.

Trawl fishing can destroy benthic habitats, because the trawl is dragged along the bottom to catch fish. A substantial trawl fishery exists in the lower Cook Inlet and Kodiak/Shelikof Strait areas for semidemersal fish (groundfish, particularly pollock). The Auke Bay laboratory of the Alaska Fisheries Science Center calculated the intensity of the bottom trawl fishery (National Marine Fisheries Service, http://www.afsc.noaa.gov/abl/MarFish/spatial_patterns.htm). Between 1990 and 1998, there were more than 157,000 estimated bottom trawls in the Gulf of Alaska and Aleutian Islands. Many of these fishing locations are repeated because of high-catch productivity. They categorized bottom trawl location to show areas of low (.007-73.817 days per 25-square-kilometer area; 0.007 days = 10 minutes); medium (73.817-364.099 days per 25-square-kilometer area); and high duration (364.099-1292.661) in days per 25-square-kilometer area (.007 days = 10 minutes). The area with the highest estimated number of bottom trawls was on the continental shelf at depths of 101-200 meters for the Gulf of Alaska and Aleutian Islands. Those shelf regions overlap much of the essential fish habitat being evaluated in this EIS. The highest number of days trawled per square kilometer occurred in the Chirikof region at depths of 301-500 meters. The magnitude of these effects contrast dramatically with the effects of pipeline construction, which are compared in Section IV.B.1.e(3)(a)2) - Offshore Pipeline Construction and Operation. Cook Inlet residents also have noted the effects of trawlers or “draggers.” (See statements from Chignik Bay, Chignik Lake, and Chignik Lagoon residents in Section III.C.3.d, which discusses regional traditional knowledge.)

Commercial fishing in Cook Inlet and the surrounding waters targets a number of fish species, which are important prey for other fish species (i.e., are critical components of essential fish habitat) as well as for birds and marine mammals. Catches of semidemersal fish (groundfish, particularly pollock), have declined steadily since the mid 1960’s and 1970’s. The walleye pollock stock is at an all-time low, and spawner biomass is expected to decline through at least 2003. Although this fishery is managed conservatively at an estimated 10% of the adult population by the North Pacific Fishery Management Council (2002), there remains the possibility of overfishing during the life of the Proposal (see Section V.C.5.k - Commercial Fisheries). A 10% annual fishing mortality is at least an order of magnitude greater than the predicted mortality for the highly unlikely 120,000-barrel oil spill (roughly one-half the size of the *Exxon Valdez* oil spill).

Commercial fisheries for herring, another forage fish in Cook Inlet, also have declined in recent years and were closed because of low abundances in 1998. Shellfish stocks also have been declining in Cook Inlet and the Kodiak/Shelikof Strait area, and many have been closed for a number of years in these waters. The dramatic decrease in the abundance of a number of marine mammals and bird species in Cook Inlet (for example, see Section IV.B.1.f - Endangered and Threatened Species) may be an indirect effect and a sign of more advanced effects of commercial fisheries on the ecosystem component of essential fish habitat.

V.C.5.e(3)(b) Global Change

Scientists generally now accept that global change is occurring (for example, Decker, Hunt, and Byrd, 1995; Helle and Hoffman, 1995). It also is generally agreed that we cannot predict the specific ecological effects of global change on fisheries (for example, Beamish, 1995; Stabeno et al., 1995; Rice, 1995). However, regime shifts in the Gulf of Alaska and Cook Inlet ecosystem often are correlated with small changes in temperature patterns (for example, Robards, et al., 1997; Anderson and Piatt, 1999). For instance, there are correlations in as little as 1-2 ºCelsius in a single month near Kodiak with an epibenthic and forage fish “regime shift” (Anderson, Blackburn, and Johnson, 1997). Regime shifts are discussed in Section III.B.3.b(1).

Many scientists believe that the change is driven by human use of fossil fuels, especially petroleum. Some of that use is discussed below in nonpoint sources resulting from human use of petroleum. Unfortunately, we understand even less about how to separate natural and human-made environmental change than we do about predicting the effects of global change (Beamish, 1995). For more information and analysis about global change, see Section 4.1.2 of the final EIS for the Outer Continental Shelf Oil and Gas Leasing Program: 2002 to 2007 (USDOI, MMS 2002).

V.C.5.e(3)(c) Nonpoint Sources Resulting from Human Use of Petroleum Products In and Around Cook Inlet

Of the human inputs of petroleum into the oceans, an estimated 84% is the result of using petroleum as a fuel (National Research Council, 2002). More than half of that is the result of petroleum consumption on land, mainly for vehicles. The amount of highway runoff in the U.S. is about 1 quart per person per year (Rice, 2001). For every 50 million people, the equivalent of an *Exxon Valdez* oil spill (or 11 million gallons, as reported by Exxon) is dumped every year intro productive coastline habitats as urban runoff (Ott, Peterson, and Rice, 2001). Furthermore, urban runoff and recreational boating are chronic sources of petroleum input into water and often occur in highly sensitive ecosystems (National Research Council, 2002).

Runoff from land-based sources of petroleum is 21% of the total input into North American waters (National Research Council, 2002), or approximately one-third of the amount from natural seeps. However, the National Research Council estimates that the range of uncertainty in the estimates of urban runoff and recreational boating is four orders of magnitude and that the upper limit, if reasonable, would dominate all other inputs (National Research Council, 2002).

Worldwide, despite the fact that large vessels (greater than 100 tons) that are not tankers make up 54% of the nontanker fleet are not allowed to dump bilge oils, the National Research Council (2002) estimates 15% of commercial and about 30% of noncommercial vessels do it anyway. That estimated discharge is an average of 4.75 gallons of bilge oil per day (5.6 thousand tons or 4 million gallons per year) and, for most commercial vessels, discharge is 365 days per year.

Based on the estimate of 1 quart of petroleum runoff from vehicles into the ocean for each U.S. resident, the input to Cook Inlet with a population of nearly 300,000 people would be more than 75,000 gallons (approximately 1,800 barrels). This input occurs every year, compared to an estimated 19% chance of a large oil spill during production from this proposed sale. Thus, every year, the petroleum products from vehicles flushed into Cook Inlet is roughly equal to the unlikely large spill from a production facility (1,500 barrels) or four-tenths of the unlikely large spill from a pipeline (4,600 barrels) evaluated in this EIS.

In Cook Inlet, many small oil spills have been documented. These spills and the risk of future spills are an issue of major concern. Between 1965 and 1980 (the most recently published data), there were a reported 269 nonpetroleum-industry oil spills; the reported amount of oil spilled for 206 of the spills was 22,746 barrels (State of Alaska, Oil and Gas Conservation Commission, 1981). The *Oil Spill Intelligence Report* (2001b) found that nontanker vessels and other unregulated operators had tenfold higher occurrence rates and fiftyfold higher volume spillage than oil industry and other regulated operators in Alaskan waters.

Spills such as these probably would drift to shore and affect some coastal and intertidal habitat. The populations of some intertidal organisms in small areas probably would be depressed measurably for about a year, and small amounts of oil would persist in shoreline sediments for more than a decade.

Between 1965 and 1980, there were a reported 269 nonpetroleum-industry oil spills; the reported amount of oil spilled for 206 of the spills was 22,746 barrels—no volume was reported for 63 spills (State of Alaska, Oil and Gas Conservation Commission, 1981). (Nonpetroleum-industry spills included spills from fishing boats, vessels carrying refined products to communities, and other vessels.)

Oil sheens observed on the water surface are another source of information about vessel oil spills. During surveillance flights in Prince William Sound and the Gulf of Alaska between September 1989 and September 1990, 260 sheens observed were attributed to sources other than *Exxon Valdez*; i.e., fishing boats, recreational boats, and cruise ships (Taft, Egging, and Kuhn, 1995); the number of non-*Exxon Valdez* slicks was about 31% of the total number of slicks observed. The estimated amount of oil in these sheens totaled about 8,100 liters (about 193 barrels) and ranged from less than 1 to 6,000 liters; the largest spill consisted of diesel fuel from a cruise vessel (see Section IV.B.1.a).

Oily ballast-water discharges also have occurred (Federal Water Pollution Control Administration, 1970) and are still occurring in the Gulf of Alaska, including Cook Inlet. Significant enforcement actions recently had to be taken against both cargo fleets (*Oil Spill Intelligence Report*, 2002) and cruise ship fleets (Henderson, 1999; *Golob's Oil Pollution Bulletin*, 1998) operating in the Gulf of Alaska for deliberately and illegally discharging oily waste.

V.C.5.e(3)(d) Oil Spills from Production and Transportation of Crude Oil

The National Research Council (2002) estimates that 3% of petroleum inputs into U.S. marine waters is from extraction of petroleum and 9% is from transportation of petroleum, including pipelines and tankers. From 1990-1999, oil tankers and oil barges were responsible for 82% of spills greater than 100 gallons. While large spills greater than 10,000 gallons accounted for only 10% of the total number of spills over 100 gallons, these large spills accounted for 85% of the volume of spillage over 100 gallons.

With this sale, the mean number of predicted oil and gas exploration and development spills in Cook Inlet increases from 0.21 (for Sales 191 and 199) to 0.58 for the cumulative case, which means that the estimated likelihood is 58%.

As discussed in Section V.C.5.a - Water Quality, Sales 191 and 199 are estimated to contribute about 30% of the future offshore oil-spill risk. Because oil produced from these sales would substitute for crude that otherwise would be tankered from Valdez into Cook Inlet and refined, the incremental spill risk from these sales in terms of number of spills is only 13%.

V.C.5.e(3)(e) Permitted Discharges Such as Municipal and Seafood Processing

Over the next 5-10 years, municipal wastewater and seafood processing discharges of organic wastes are estimated to contribute double the inputs of oil industry produced water (as described in Section V.C.5.a - Water Quality).

V.C.5.e(4) Past, Current, and Future Cumulative Activities

Section 4.1.0 of the final EIS for the Outer Continental Shelf Oil and Gas Leasing Program: 2002 to 2007 evaluated the relationship between short-term uses of the human environment and the maintenance and enhancement of long-term productivity (USDOI, MMS, 2002). That EIS evaluated the effects of Federal offshore oil and gas leasing throughout the United States. It concluded that "this proposed action will contribute to the continuing alteration of nearby coastal areas, from biologically productive natural environments to urbanized and industrialized environments."

The extent to which ecologically complex essential fish habitats are changed by small, sublethal effects on that habitat from cumulative human development such as fishing, chronic urban contamination, numerous small fuel spills, and by this lease sale is largely unknown. For essential fish habitat both locally in Cook Inlet and globally, the cumulative effects depend in part on whether the changes occur at a crucial time period or in a critical location.

The National Research Council report *Oil in the Sea, III* (2002) also addressed the state of knowledge about the cumulative effects of oil on marine ecosystems. The following information is derived largely from that report but is echoed by many other professionals in numerous scientific journals.

The National Research Council (2002) documents numerous sources of underwater noise that affect essential fish habitat, including vessels. Supertankers cruise at 17 knots (approximately 20 miles per hour), filling the frequency band below 500 Hertz with a steady sonic blare reaching 190 decibels or more (up to 205 decibels at the low frequencies). Annually, 1,500 petroleum tankers, or one-third of the global fleet, enter U.S. harbors.

Midsized ships such as tugboats and ferries produce sounds of 150-170 decibels in the same range. The 1990's saw the development of two other significant sources of undersea noise: acoustic thermometry and low-frequency active sonar. Thermography requires as many as 12 transoceanic loudspeakers, emitting 195-decibel, low-frequency tones at regular intervals, perhaps for decades. Low-frequency active sonar methodology involves using a small battery of boats to sweep the oceans with low-frequency sound, reportedly at more than 230 decibels near the source.

The effect on fish habitat usually results in behavioral changes of the fish in those habitats, especially temporary displacement into other areas. Behavioral changes may hinder an animal's survival without actually damaging its hearing, for example, disrupting migration, breathing, nursing, breeding, feeding, and sheltering (Jasney and Reynolds, 1999).

Assessing recovery after a pollution event is perhaps even more challenging than assessing initial damage. Recovery is further removed in time from the acute phase of the damage and, thus, may be occurring in a different environmental framework than that which existed at the time of the accident. Although we now know much more about the toxicity and sublethal effects of petroleum hydrocarbons to organisms, we still have great difficulty in assessing the population, community, or ecosystem effects of pollution events. Appreciation of the influence of decadal-scale and longer climate change means that we cannot expect communities or ecosystems to return to the state in which they were at the time of a pollution incident.

Because the causes and results of this or future Cook Inlet regime shifts are not known, the portion that this lease sale contributes to cumulative development impacts is difficult to measure. Possible measures include:

- 1% as measured by a 1-2% increase in Kenai Peninsula Borough employment;
- 1% based on contribution to boat and vessel traffic and associated small, often unreported fuel spills;
- a small fraction of a percent of the total burning of fossil fuels from this sale would contribute to global warming and delay serious development of alternative energy sources; and
- 14-30% risk of a large but unlikely oil spill.

The primary cumulative effect of this sale is incremental human and industrial development. The contribution of this sale to adverse effects on essential fish habitat from development is considered low. Similarly, except for the potential risk of a large oil spill, which is considered unlikely, the contribution of this sale, along with other oil development in Cook Inlet, to adverse effects on essential fish habitat from development are considered low.

As indicated earlier in the cumulative analysis of this Proposal (see Section V.C.5.d - Commercial Fisheries), "development actions have changed locally the distribution and abundance of some food web and vertebrate components of the ecosystem. Whether the seasonal levels of productivity of regional fisheries populations have been affected by development remains largely unknown." By extension, essential fish habitats also have been cumulatively changed by development.

The National Research Council (2002) also discussed how difficult it is to identify effect and even whether recovery has occurred. They found that it is exceedingly difficult to quantify the effects of oil in the sea or to establish when recovery from a pollution event is complete. The inputs and long-term fate of land-based sources (due both to runoff and to atmospheric deposition) are poorly understood. The range of uncertainty of land-based runoff of petroleum hydrocarbons is four orders of magnitude. There is a lack of information about the synergistic interactions in organisms between hydrocarbons and other classes of pollutants. This problem is particularly acute in areas subject to chronic pollution (for example, urban runoff). Research on the cumulative effects of multiple types of hydrocarbons in combination with other types of pollutants is needed to assess toxicity and organism response under conditions experienced by organisms in polluted coastal zones.

There are demonstrable sublethal physiological effects of long-term, chronic releases of hydrocarbons into the marine environments. That includes urban runoff, where oil incorporates in sediments and is released back to the water column, and in oil-production fields. If oil is incorporated in the sediments or structure of the habitat, recovery of the habitat and the organisms that depend on it may be exceptionally slow.

There is little information on the effects of either acute or chronic oil pollution on populations or on the function of communities or ecosystems. The structure of populations of most marine organisms is poorly known because of the open nature of communities and the flow of recruits between regions. Unreported factors not related to oil can interfere with ecosystem processes in ways that disguise the effects of pollution. With each additional kind of impact that is measured, the chance of other factors disguising the effects of pollution on the ecosystem rises.

At the same time, the mosaic of complex interactions and the resultant changes in ecosystems makes it possible to miss an impact that occurs. For example, if an oil spill or other impact occurs when the pelagic larval stages of a fish species are developing near the sea surface, many or most of these larvae may die. If these larvae were to be the foundation of what would otherwise have been a strong year class for that fish species and whose populations are maintained by infrequent large year classes, then the impact could be much larger than otherwise supposed. That would be a disproportional effect on a process that is temporally constrained. There also are examples of potential impacts on processes that are disproportionate because they are spatially constrained. For instance, a small spill around a habitat where a large proportion of a population is gathered for breeding could have a disproportionately large impact.

A regime shift in the Cook Inlet commercial and forage fisheries structure and the prey of the forage fish in Kachemak Bay (Bechtol, 1997) and Shelikof Strait (Anderson, Blackburn, and Johnson, 1997) since the early 1970's is described in Section IV.B.1.e. Implicit in the concept of regime shift is that changes occur throughout the ecosystem and a new community structure is formed (Anderson, Blackburn, and Johnson, 1997). The Kodiak Island shift occurred rapidly and may shift again from a fish-dominated to another community regime (Anderson, Blackburn, and Johnson, 1997). There are many potential stable states an ecosystem can settle into (May, 1977) after a regime shift. Small changes due to offshore oil and gas development and production could act synergistically to increase the likelihood of a change from other causes. Small changes also could be countervailing, decreasing the likelihood of a regime change caused by other human actions. An example of synergistic interactions is in effects of oil spills is phototoxicity. In a study for the MMS, Duesterloh and Shirley (2001) found that ultraviolet light rays enhanced toxicity to zooplankton by a factor of 1,000 in the presence of ultraviolet radiation. Barron et al. (2002) found part-per-billion aqueous concentrations of Alaska North Slope crude oil in the presence of sunlight can damage or kill herring embryos and larvae. As little as 2.5 hours per day for 2 days significantly increased toxicity. The results also suggest the potential for photo-enhanced toxicity as a factor in herring impacts from the *Exxon Valdez* oil spill because of the high photo-toxicity of weathered Alaska North Slope crude oil and measurements of parts per billion levels of total polycyclic aromatic hydrocarbons in the water column during the 1989 spill, the high photo toxicity of weathered North Slope crude oil, and the limited ultraviolet necessary to cause photo enhanced toxicity (Barron et al., 2002).

V.C.5.e(5) Cumulative Effects from Oil Spills from OCS and State of Alaska Oil and Gas Activities

Based on the experience with the *Exxon Valdez* oil spill Inlet (Short and Harris, 1996; Neff and Stubblefield, 1995), hydrocarbon contamination in surface and subsurface waters in the vicinity of the slick would be expected to be less than a tenth of the chronic criterion, less than 1 part per billion total aromatic hydrocarbon, by the time the slick reached Cook Inlet. Thus, the primary effect of such a spill would be physical presence of the slick on the water, rather than chemical toxicity.

The predicted damage due to a spill remains the same. Those effects are primarily moderate damage to beach and intertidal fish habitats, because oil could remain in these habitats for from several months to more than a decade, affecting the habitat of some species of fish and their prey (a significant impact; see Section IV.B.1.e).

The greatest potential (but still unlikely) direct impact to essential fish habitat is damage from an oil spill. The cumulative industry oil-spill risk to essential fish habitat is a 58% chance of a large spill, triple the risk of this sale. That is, proposed Sales 191 and 199 are estimated to contribute 36% of the cumulative risk of an oil industry oil spill.

However, while the probability of a spill is increased, this proposed sale also could decrease oil tanker traffic in Cook Inlet by 13%, because the oil discovered and developed would be used in Nikiski, replacing oil supplies tankered from Valdez to Nikiski. As discussed in Section V.C.5.a - Water Quality, supplying Nikiski the oil developed from this sale through an offshore pipeline instead of supplying oil from Valdez by oil tanker would decrease the risk of an oil tanker spill by 13%, making this sale's contribution only 23% of the cumulative risk of an oil industry oil spill.

V.C.5.e(6) Transportation Effects Along the Oil Transportation Route

The habitat of Cook Inlet fish, most notably Pacific salmon, extends beyond Cook Inlet. Cook Inlet salmon migrate to the large gyre circulating in the Gulf of Alaska, where they live and grow for one to several years before returning to Cook Inlet to spawn. Their path may cross the oil transportation route. Therefore, oil tanker transportation of Alaska North Slope (Prudhoe Bay) oil from Valdez to the West Coast of the United States is also being considered in this cumulative analysis. Because the tankers must travel up to 55 kilometers (30 miles) from shore, the tanker spills are assumed not to affect the habitat of Cook Inlet fish species other than salmon.

Vessel noise disturbance of essential fish habitat (resulting in displacement of fish) would occur along the transportation route. Supertankers cruise at 17 knots (approximately 20 miles per hour), filling the frequency band below 500 Hertz with a steady sonic blare reaching 190 decibels or more (up to 205 decibels at the low frequencies).

The effects of the tanker traffic are temporary deterioration of salmon habitat due to vessel noise, resulting in temporary behavioral changes of fish, especially displacement. Behavioral changes may hinder an animal's survival with out actually damaging its hearing, for example, disrupting migration, breathing, nursing, breeding, feeding, and sheltering (Jasny and Reynolds, 1999).

The number of cumulative tanker spills outside of Cook Inlet is estimated to be six, with an average size of 3,000 barrels. For purposes of analysis, one spill is assumed to be 250,000 barrels (slightly less than the 257,000 barrels spilled by the *Exxon Valdez*), and the other five spills are assumed to be less than 15,000 barrels, of which two spills would be 13,000 barrels average size. The spills are expected to occur 100 nautical miles offshore.

The primary impact to essential fish habitat for salmon is a temporary decrease in habitat water quality until oil is weathered and dispersed to the extent it will no longer be toxic. See the water quality Sections IV.B.1.b and V.C.5.a for more details. Sublethal effects could include decreased growth that could, in turn, lead to decreased survival or reproductive success. Although it is unlikely that rearing salmon from Cook Inlet would encounter the spill, there is a possibility that a few to many thousands of rearing Cook Inlet salmon could be affected.

Small sections of intertidal and beach habitats could be damaged for a few months up to a decade or longer.

If oil reached intertidal habitats, salmon-spawning habitat could be affected. The very shallow nearshore estuarine habitats that juvenile salmon favor just after leaving freshwaters also could be affected.

The spill model predicts a 5-10% chance of contacting shore within 30 days. In most cases, this is unlikely to be spawning habitat of Cook Inlet salmon or the very shallow coastal habitats of juvenile Cook Inlet smolts that have just exited freshwater. (It could affect the habitat of other salmon populations along the coast of Alaska, Canada, or the western U.S.) One large, highly unlikely spill in the Gulf of Alaska of 250,000 barrels (slightly less than the *Exxon Valdez* oil spill of 257,000 barrels) could extend into Cook Inlet.

V.C.5.f. Endangered and Threatened Species

V.C.5.f(1) Conclusion

The significance of potential cumulative effects on many of the threatened and endangered species that occur within or near proposed Sale191 area are uncertain. However, common past, current, and predicted human-related factors that have impacted, and could again adversely impact, some or all of the threatened, endangered, candidate, and delisted species that we considered include:

- *marine and terrestrial habitat contamination with harmful contaminants;*
- *habitat loss and degradation at important feeding, nursery, and other habitats due to increased noise, disturbance, and alteration related to human settlement, development, and activities such as fishing, mariculture, and tourism;*
- *human-related and other changes in the size and composition of marine fish populations;*
- *human harvest;*
- *take associated with commercial fishing; and*
- *global warming.*

Pollution of marine and terrestrial habitats occupied by these species occurs from many human-related sources, such as sewage inputs, petroleum hydrocarbons from sources related to oil use and oil spills, contaminants from industrial and agricultural activities, and many other sources. Long-distance transport of contaminants can occur. Persistent organochlorine contamination may pose a particular threat to threatened and endangered marine mammal populations. Contaminants led to the previous endangered status of the American peregrine falcon and could be contributing to the apparent decline in the American breeding population of Steller's eiders.

It is unlikely that cetaceans other than the Cook Inlet beluga whale have been exposed to adverse effects of State oil and gas leasing in the inlet. No serious adverse effects from this activity have been identified on beluga whales. Available data do not indicate previous OCS oil- and gas-related adverse effects on the cetacean stocks that could be affected by the proposed Cook Inlet sales. Sea otters in the region of the designated Southwest Alaska stock of sea otters and in other regions previously have suffered serious adverse effects from oil spills. The impacts of increased noise in the marine environment on the species at issue are mostly unknown but potentially could have adverse effects such as disruption of communication and avoidance of important habitats. Many of the threatened and endangered species are known to have suffered mortality related to commercial-fishing operations (from entanglement in derelict or active fishing gear and, in some cases, intentional killing associated with the fishing operations of sea lions and sea otters). Such take still may be occurring. However, in most cases, information is insufficient to make firm conclusions about levels of take. All of the threatened, endangered, and candidate species of marine mammals and the short-tailed albatross previously have suffered serious adverse effects from intentional killing by humans. This overexploitation of these stocks reduced population size, disrupted historic population structures, reduced historic distributions, could have led (in many cases) to loss of genetic variability within populations and, in all cases but that of the sea otter, is the primary or one of several primary factor(s) leading to the current ESA status of the marine mammal species or population. With the exception of high levels of intentional killing, all of the aforementioned sources of adverse effects still exist. Sea lions, sea otters, and Steller's eiders are still hunted. The extent of harvest of Steller's eiders from the American breeding population is unknown. Aleutian Canada geese are still occasionally harvested. Global warming could impact some of the threatened and endangered species of concern here if such warming resulted in changes in prey or predator distribution, abundance, or both. Nesting habitat of avian species, such as Steller's eiders, could also be modified by global warming. There is considerable uncertainty about the extent to which all of the aforementioned factors may interact to modify or degrade the marine environment and, thus, to cause potentially long-term adverse effects on the species considered here.

We expect potential incremental cumulative effects attributable to proposed Sale 191 to be insignificant for blue whales, sperm whales, sei whales, North Pacific right whales, short-tailed albatross, American peregrine falcons, and Aleutian Canada geese. In the absence of a very large oil spill, we would expect any incremental effects attributable to proposed Sale 191 to be insignificant for all of the aforementioned species, all ESA-listed and candidate cetaceans, for the eastern population stock of Steller's sea lions, for Steller's eiders, and for the southwest Alaska stock of sea otters.

The primary potential for significant incremental contributions to cumulative adverse effects on threatened and endangered species from routine operations could result from incremental increases in noise and disturbance at key western Steller sea lion stock terrestrial and foraging critical habitats and other habitats that resulted in Steller sea lions avoiding important feeding habitats or to direct mortality. Any large displacement, particularly of juvenile Steller sea lions, from important foraging habitats could result in a significant cumulative adverse effect on this species. Any such displacement from marine critical habitats could result in a significant adverse cumulative effect on that critical habitat. Displacement from important feeding habitats would not have to be years in duration to have a potentially significant cumulative effect, especially if juveniles were displaced. Such a cumulative effect is considered unlikely from routine operations, unless Steller sea lions avoided important foraging areas due to noise or other disturbing activities that occurred within or very near their critical habitats. Any disturbance of the western population stock of Steller sea lions at their terrestrial critical habitats that resulted in mortality (for example, due to trampling) could result in a potentially significant negative adverse effect on both the western population stock of Steller sea lions and on that critical habitat. Any potential increase in mortality of Steller sea lion prey species in sea lion critical habitat that resulted in a large decrease in prey available to the western stock of Steller sea lions could result in a potentially significant cumulative effect on both the stock and on the critical habitat. Such a significant effect on prey probably is possible only in the unlikely event of a large or very large oil spill that contacted critical habitat or other important feeding areas and reduced availability of Steller sea lion prey. Such a large or very large spill also conceivably could result in a significant cumulative effect if it resulted in the exposure to large amounts of fresh crude oil by Steller sea lions, particularly if it resulted in the oiling of pups.

In the unlikely occurrence of a large oil spill, the incremental impact on the Southwest Alaska population of sea otters, and less likely on the American breeding population of Steller's eiders, could result in a significant cumulative effect on these two populations. There is a small possibility that a large or very large oil spill that occurred in the upper part of Cook Inlet could result in a significant cumulative effect on the Cook Inlet stock of beluga whales, if such a spill occurred. However, existing data indicate that such an effect would be unlikely.

V.C.5.f(2) Introduction

The potential cumulative effects of the Proposed Action on many of the threatened and endangered species that can occur within or near the proposed program area is uncertain, because basic knowledge of the population structure, population identity, migration routes, and other key life-history information is uncertain or unknown for some of these species. For example, for most of the whale species, we do not know where population boundaries lie. For this reason, population estimates and population trends are, for many species, unclear or known. For this reason also, it is not always clear what human-related impacts there are on a particular population, what the magnitude of the impacts are and, most importantly, whether such potential impacts (for example, death or injury due to fishing-gear entanglement or contaminant exposure) are having a significant effect on the population. Because of the aforementioned, the cumulative effects on a population and the significance of any potential negative contribution from the Proposed Action are, in some cases, difficult to assess.

With respect to many of the cetaceans, it often is difficult to determine the cumulative impacts, because the whales are out at sea and adverse impacts are not observed. For example, with respect to the recorded levels of impacts of fishing-gear entanglement on fin and sei whales, Reeves, Silber, and Payne (1998:29) caution:

> …Heyning and Lewis (1990) suggested that most whales killed by offshore fishing gear do not drift far enough to strand on beaches or to be detected floating in the nearshore corridor…Thus, the small amount of documentation should not be interpreted to mean that entanglement in fishing gear are insignificant causes of mortality. Observer coverage in the Pacific offshore fisheries has been too low for any confident assessment of species-specific entanglement rates (Barlow et al., 1997). Fin and sei whales may break through or carry away fishing gear. Whales carrying gear may later die, become debilitated or seriously injured, or have normal functions impaired, with no evidence recorded.

This statement, while directed at effects on whales from fisheries, is true for interpretation of impacts from many factors including impacts of prey removal in fisheries, exposure to petroleum hydrocarbons or contaminants, exposure to noise, and hunting. With respect to the latter, information that has just recently emerged about the impacts of previous illegal Soviet whaling (for example, on North Pacific right whales) and from studies indicating other illegal take of protected cetaceans, indicates that the available information about takes may not be complete or even reliable.

V.C.5.f(3) Cumulative Effects on Marine Mammals

Common past, present, and predicted human impacts affect many of the marine mammals that inhabit the Cook Inlet and Gulf of Alaska regions.

V.C.5.f(3)(a) Contaminants

Marine mammals that inhabit arctic and subarctic waters of the North Pacific, including Cook Inlet, may be affected by low levels of contaminants. These toxins become concentrated in tissues of species near the top of the food chain. For example, available data indicate that arctic and nearby oceanic waters serve as a sink for persistent contaminants, many of which are used in low-latitude developing countries. Tanabe, Iwata, and Tatsukawa (1994) concluded that marine mammals, particularly cetaceans, are one of the animal groups receiving high concentrations of one class of such contaminants, persistent organochlorines. Tanabe, Iwata, and Tatsukawa (1994) concluded that marine mammals amplify great amounts of these contaminants through feeding and pass them from one generation to the next through lactation. These authors reported that, due to specific enzyme systems, marine mammals have a smaller capacity than many other types of animals for degrading such contaminants. They concluded:

> …the residue level of these contaminants in marine mammals are unlikely to degrade in the near future….it may be concluded that marine mammals are one of the most vulnerable and possible target organisms with regard to long-term toxicity of hazardous man-made chemical in the future.

O'Shea and Brownell (1994) found that organochlorine contaminant levels in baleen whales was relatively low compared to other marine mammals, and that detected levels provided no reason to suspect that exposure has caused either direct lethality or impaired reproduction in baleen whales. However, they pointed out that, at the time of their review, no thorough study of potential impacts of contaminants existed for any species of baleen whale.

Reported effects of organochlorines include immunotoxicity, hepatotoxicity, neurotoxicity, reproductive and hormonal effects, abnormal effects on metabolism, mutagenesis and carcinogenesis, and/or skin lesions (Safe, 1984) in species such as dolphins in the Mediterranean (Poster and Simmonds, 1992)' seals in the North and Baltic seas (Heide-Jørgensen et al., 1992); St. Lawrence estuarine beluga whales (Martineau et al., 1987); and fish-eating birds (Kubiak et al., 1989).

In pinnipeds, organochlorines have been associated with reproductive failures of seals in the Dutch Wadden Sea and elsewhere (Hutchinson and Simmonds, 1994). In the American mink *(Mustela vison*), a species relatively closely related to sea otters, reproduction was inhibited at very low polychlorinated biphenyl intake (den Boer, 1983). In monkeys and other species, polychlorinated biphenyl exposures were found to have negative effects on birth weights, conception rates, and live birth rates. The effects of polychlorinated biphenyl exposure on reproduction and related factors are likely to be long lasting. Effects in monkeys were observed long after the dosing with polychlorinated biphenyls occurred. Sperm counts were reduced in rats exposed to polychlorinated biphenyls (Environmental Protection Agency, Office of Pollution Prevention and Toxics web site).

Polychlorinated biphenyls also have important potential impacts on survival rates of all age classes of marine mammals, due to their impacts on the immune system and their potential to predispose individuals with high contaminant loads to infectious disease.

Chemicals such as polychlorinated biphenyls, polychlorinated dibenzo-p-dioxins (PCDD's), and polychlorinated dibenzofurans (PCDF's) have been found to be immunotoxic at low doses in studies of laboratory animals, and to accumulate in the tissues of higher trophic marine mammals such as seals (Van Loveren et al., 2000). Van Loveren et al. (2000:319) concluded:

> …that complex mixtures of environmental contaminants including polychlorinated biphenyls, PCDFs, and PCDDs may represent a real immunotoxic risk to free-ranging seals.

Coplanar polychlorinated biphenyls have been associated with mass mortalities of seals in the North Sea and Lake Baikal, epizootics in Mediterranean striped dolphin, and embryonic abnormalities in Great Lakes waterbirds (Tanabe, Iwata, and Tatsukawa, 1994). Some investigators have suggested that the primary lesion of the adrenals, one of a combination of lesions found in Baltic grey and ringed seals as a disease complex, may be caused by organochlorines, specifically by polychlorinated biphenyls (Bergman and Olsson, 1986; Olsson, Karlsson, and Ahnland, 1994). Findings from studies of potential associations between chronic exposure to polychlorinated biphenyls and infectious disease mortality in harbor porpoises from England and Wales were "…consistent with the hypothesis that chronic polychlorinated biphenyl exposure predisposes harbour porpoises in United Kingdom waters to infectious disease mortality…." (Jepson et al., 1999:243). Tanabe, Iwata, and Tatsukawa (1994:172) concluded:

> …the present status of contamination by organochlorines in the marine ecosystems has also reached the critical point which might be enough to cause the induction of P-450 enzymes and disturbance of enbiotics in organisms…such as marine mammals.

Studies summarized by the Environmental Protection Agency (Office of Pollution Prevention and Toxics Studies) document many serious impacts of polychlorinated biphenyl exposure on the immune system of monkeys and other animals. These impacts include: (1) a significant decrease in size of the thymus gland (a gland critical to the functioning of the immune system) in infant monkeys; (2) reduced responses of the immune system following a standard laboratory test that determines the ability of an animal to mount a primary antibody response and develop protective immunity; and (3) decreased resistance to viral and other infections. The Environmental Protection Agency writes: "Individuals with diseases of the immune system may be more susceptible to pneumonia and viral infections. The animal studies were not able to identify a level of polychlorinated biphenyl exposure that did not cause effects on the immune system."

There also is "…overwhelming evidence that polychlorinated biphenyls cause cancer in animals…The reassessment…concluded that the types of polychlorinated biphenyls likely to be bioaccumulated in fish and bound to sediments are the most carcinogenic polychlorinated biphenyl mixtures" (Environmental Protection Agency, Office of Pollution Prevention and Toxics web site).

V.C.5.f(3)(b) Noise and Disturbance

Noise and disturbance in the marine environment may have major cumulative impacts on marine mammals and especially cetaceans. Significant and increasing sources of noise and disturbance include, but are not limited to (a) noise from shipping (for example, tankers, icebreaking ships, barges, tour ships, factory trawlers); (b) other vessel traffic (for example, smaller fishing boats, high-speed motorboats, float planes); (c) low-frequency active sonar used by the military to detect "silent" submarines; (d) seismic surveys; (e) underwater explosions related to construction, mineral mining, and military activities; (f) oil rigs; and (g) other construction.

Disturbance is possible from all of the aforementioned. In addition, disturbance to nearshore marine mammal populations comes from mariculture sites, human settlements, tour operations, dredging, harbor construction, commercial and sport fisheries, and many other sources.

V.C.5.f(3)(c) Shifts in Composition of Marine Fish Stocks

Changes in the composition of fish stocks, in some cases possibly driven by (Hatch and Piatt, 1995), explosive growth and changes in commercial fisheries in the northeastern Pacific, correspond to declines in certain seabird species and Steller sea lions in the Gulf of Alaska (Merrick, Loughlin, and Calkins, 1987; Pitcher, 1990). For example, in the Gulf of Alaska, a shift occurred in the late 1970's and early 1980's toward increased abundance of walleye pollock, cod, and various flatfishes. This increased abundance occurred possibly at the expense of (Alverson, 1992) other species that are prey for a number of threatened and endangered species in the Gulf of Alaska regions (for example, Steller sea lions), including herring, sand lance, and capelin. Piatt (unpublished data, cited in Hatch and Piatt, 1995) found that the diets of some seabird species, including murrelets, shifted from being primarily capelin based to being primarily pollock based coincident with the change in relative abundance of the fish species. Hatch and Piatt (1995) stated: "The wholesale removal of large quantities of fish biomass form the ocean is likely to have major, if poorly known, effects on the marine ecosystem. An emerging issue is whether fish harvests are altering marine ecosystems to the detriment of seabirds and other consumers like pinnipeds and whales."

Global warming could affect distribution and abundance of certain marine invertebrates and vertebrates that are prey species to cetaceans, Steller sea lions, and albatrosses. If such a shift were to occur, there could be adverse impacts on some species such as Steller sea lions if, for example, nursing females or juveniles were forced to feed farther from rookery or haulout locations. Predictions about rates or patterns of such potential effects on marine ecosystems are very difficult to predict because of the complexity of the ecosystem.

V.C.5.f(3)(d) Cumulative Effects on Cetaceans

Except for the Cook Inlet beluga whale, the other cetaceans discussed here are unlikely to have been exposed to adverse impacts of State oil and gas leasing. State sale areas generally have been confined to waters north of Kachemak Bay. Fin whales are not common in the upper Inlet. The other threatened and endangered cetaceans, except for humpback whales, tend not to go into the Inlet at all. Humpback whales rarely venture past Kachemak Bay. The National Marine Fisheries Service (1993) summarized that the six species of large endangered whales considered here are less exposed to OCS activities in other areas than is the previously listed gray whale.

All of the cetaceans discussed here are endangered or in their current depleted state because of direct and purposeful take by humans. As summarized in the section on the affected environment, early commercial harvest of all species of great whale considered in this EIS—blue, fin, humpback, North Pacific right, sei, and sperm—had substantial adverse effects on the affected species. For some of these species, such as the North Pacific right whale, intensive whaling began prior to the previous century, and overexploitation continued into the 1960's. All of the species of great whale are now protected from whaling, but undocumented levels of illegal take have occurred at least as recently as the late 1990's (for example, see Baker et al., 2000). The Cook Inlet beluga whale recently suffered overexploitation by Alaskan Natives (for example, see Mahoney and Shelden, 2000). Available information regarding estimates of pre-exploitation size is presented in the affected environment section.

The great whales also are subject to adverse effects of ecosystem degradation. In a recent review of cetacean vulnerability to ecosystem degradation, Clapham and Brownell (1999:4) derived probable criteria to classify cetaceans with regard to their likely vulnerability to ecosystem degradation:

> Criteria…primarily involve the rarity of the animal and whether its distribution is commonly coastal. Those species which we do not consider vulnerable are those which feed or breed in offshore waters that are largely undisturbed by human development or activity. Populations which appear to be large (irrespective of their migratory habits) are also unlikely to be vulnerable….

Clapham and Brownell (1999:1) summarized that whales that feed, breed, or migrate through coastal waters are those that are most likely to be vulnerable to ecosystem degradation.

> Types of degradation include heavy ship traffic (resulting in collisions or behavioral disturbance), fisheries operations (leading to entanglement and perhaps depletion of prey…), disturbance from tourism, industrial activity (notably oil and gas development), direct exploitation, coastal development and pollution.

Cetaceans and other marine mammals also can be adversely impacted by commercial fisheries. Primary pathways of impact for commercial-fishing operations on ESA-listed whales include incidental take and entanglement in actively fishing and discarded gear, shooting during fishing operations (this tends to be a problem for toothed but not baleen whales), effects on prey abundance, and disturbance. Known current rates of entanglement, direct take, and incidental take of population stocks of great whale in the North Pacific are low. Thus, the National Marine Fisheries Service (2001b:4-216) found that "…the cumulative effect of take and entanglement is found to be cumulative but considered insignificant to all of the great whale species that occur in the BSAI and GOA [Gulf of Alaska]." The National Marine Fisheries Service (2001b) did not identify direct or indirect effects of groundfish fisheries on the prey of great whales and, therefore, did not identify a cumulative effect on prey abundance for these whale species. Lastly, the National Marine Fisheries Service (2001b) concluded that there were past external effects of disturbance from foreign/joint venture fisheries, other fisheries, and subsistence and commercial harvest on great whales throughout their range. Present and predicted effects of disturbance are similar.

Read and Wade (2000:933) concluded the following with regard to the state of knowledge of the take of cetaceans and pinnipeds in set and drift gillnet fisheries relative to the Potential Biological Removal for the stock:

> Because so few fisheries have been monitored in Alaska, we do not know the magnitude of these takes. Therefore, although only a few stocks in Alaska had takes greater than PBR [Potential Biological Removal], this result should be considered uncertain pending observations of the many category II gill-net fisheries in that area.

None of the threatened and endangered species of cetaceans considered here are known to have suffered harm from the 1989 *Exxon Valdez* oil spill, or from previous spills in Cook Inlet, such as the *Glacier Bay* oil spill.

V.C.5.f(3)(d)1) Cumulative Effects on Beluga Whales (Cook Inlet Population Stock Only)

Moore et al. (2000) recently provided a detailed review of potential human caused impacts on Cook Inlet beluga whales and their habitat. Human activities that were identified as of concern to the Cook Inlet beluga stock included commercial fishing, oil and gas development, municipal discharges, noise from aircraft and ships, shipping traffic, and tourism.

In October of 2000, the National Marine Fisheries Service (2000:38) examined "…all factors that have been identified that may contribute to the cumulative impact on the …stock, and its habitat in the Inlet."

These factors included subsistence harvest; natural mortality due to strandings, predation and disease; prey availability in Cook Inlet; potential interaction with State fisheries in Cook Inlet; oil and gas development in the Inlet and adjacent lands; municipal activities; commercial-vessel traffic; impacts from noise; and potential impacts from National Marine Fisheries Service research activities. We refer readers to the aforementioned document (National Marine Fisheries Service, 2000) for details on potential cumulative impacts to Cook Inlet belugas that are beyond the scope of this document.

The National Marine Fisheries Service (2000:1-2) summarized that:

> A review of the natural and anthropogenic factors potentially impacting the stock of CI beluga whales indicates that subsistence harvest is the most likely cause of the decline observed between 1994 and 1998…The impacts of other anthropogenic factors of CI beluga whales were also considered. No current population-level effects are thought to be occurring due to man-induced factors except for the harvests. The upper Cook Inlet region is important habitat to this stock, and NMFS believes that the potential pressures from activities need continued monitoring with the recovery of the beluga whales in mind. However, with the exception of the subsistence harvest, none of the other identified activities can be directly linked to the recent decline in CI beluga whales, nor does any of the information available support a deleterious impact on the health of the beluga whales or any impact that would inhibit the recovery of the whales.

In 2001, the National Marine Fisheries Service (Angliss, DeMaster, and Lopez, 2001:87) summarized that

> …no indication currently exists that these activities have had a quantifiable adverse impact on the beluga population. The best available information indicates that these activities, alone or cumulatively, have not caused the stock to be in endangered of extinction (June 22, 2000, 65 FR 38778; Draft Environmental Impact Statement on Federal Actions Associated With the Management and Recovery of Cook Inlet Beluga Whales, October 2000, Alaska Regional Office, National Marine Fisheries Service….

The National Marine Fisheries Service (Angliss, DeMaster, and Lopez, 2001) summarized that the stock may currently have heightened susceptibility to adverse impacts because of their currently reduced state and more restricted range.

The National Marine Fisheries Service (1999) summarized anthropogenic impacts on Cook Inlet. Fishing bycatch was considered low in all regions of Cook Inlet. Oil and gas potential impacts were categorized as high for the west sides of the "low" and "moderate" summer use areas and low in "high" summer use areas.

Human transportation impacts were classified as high near Anchorage, and in the central waters of the upper and lower Inlet. They summarized water quality as poor in the region of the shoreline from the Beluga River into Knik Arm and the shoreline from Point Possession to Chickaloon Bay, and in Turnagain Arm and remaining shoreline areas of Cook Inlet. Water quality was rated as moderate in the central waters of the inlet.

Oil spills. There are no data indicating the beluga whales from the Cook Inlet stock suffered any adverse effects from the 1989 *Exxon Valdez* oil spill in Prince William Sound or the 1987 *Glacier Bay* oil spill in Cook Inlet (near Nikiski). The latter oil spill occurred in July in an area where beluga whales commonly are found (National Marine Fisheries Service, 2000).

V.C.5.f(3)(d)1)a Native Take

As summarized in the affected environment section, Native take of beluga whales in the 1990's was unsustainably high, and evidence indicates this take caused the recent decline in abundance of this stock (see Mahoney and Shelden, 2000). Between 1993 and 1998, reported take ranged from 21-123 whales per year, for a mean annual take of 65 belugas per year. As discussed in the affected environment section, Native take now is regulated and limited to two strikes per year, for a total of six strikes in 4 years. The regulation of Native take is considered permanent and is expected to remain in place at least until the stock is considered to have recovered from its current depleted status. There were no reported belugas taken by Alaskan Native subsistence harvests in 1999 or 2000. In 2001, the village of Tyonek took one whale.

V.C.5.f(3)(d)1)b) Commercial Fisheries Interactions

Evaluation of recent levels of commercial-fishery interactions with Cook Inlet beluga whales is hampered by sampling problems associated with the logbook reporting program during 1990-1993 (National Marine Fisheries Service, 2000), and because fisher self-reporting programs likely provide only minimum estimates of interaction levels (Hill and DeMaster, 1998). Keeping in mind those caveats, no interactions between beluga whales and northern Gulf of Alaska groundfish trawl, pot, or longline fisheries were reported during 1990-1999 (Hill and DeMaster, 1998). From 1995-1999, there were no self-reports of injury or mortality to beluga whales from fishers in the lower Cook inlet herring sac-roe fishery, mechanical/hand-jig fishery for lingcod and rockfish, or salmon purse-seine fisheries (National Marine Fisheries Service, 2000). From 1995-1999, there were no self-reports of injury or mortality to beluga whales from the razor clam hand-dig fisheries, herring gillnet fisheries, or salmon drift- and set-gillnet fisheries in upper Cook Inlet. Observers were deployed in the salmon driftnet fishery, and upper and lower Cook Inlet set-gillnet fisheries were observed in 1999 and 2000. Preliminary data showed that during 6,123 hours of observation by 30 biologists of about 4,258 hauls of drift and set gillnet fisheries, no marine mammal mortalities were observed. Only three sightings of were made of beluga whales in 1999, each from an observer at a set-gillnet site in upper Cook Inlet (National Marine Fisheries Service, 2000; Merklein, Fadely, and van Atten, unpublished presentation and data, provided by Fadely, 2003, pers. commun.). Beluga whales were not observed within 10 meters of a net in the set or drift gillnet fisheries. Murray and Fay (1979, cited in Hazard, 1988) reported that five beluga whales were taken in salmon gillnet fisheries in Cook Inlet in 1979. Burns and Seaman (1986) estimated that three to six beluga whales were taken incidental to commercial salmon gillnet fisheries in Cook Inlet during 1981-1983. There are reports of takes of beluga whales in Cook Inlet commercial salmon gillnet fisheries. With respect to personal-use fisheries, the National Marine Fisheries Service (2000) summarized that they are unaware of any injury or death of a beluga whale associated with the Cook Inlet personal-use/subsistence gillnet fisheries.

V.C.5.f(3)(d)2) Cumulative Effects on Blue Whales

Evaluation of potential cumulative effects on blue whales that inhabit the Gulf of Alaska are hampered by the lack of knowledge about migration routes, overwintering areas, and population structure. Thus, the nature and the magnitude of threats to the population of whales that occur seasonally in the Gulf of Alaska are mostly unknown.

The National Marine Fisheries Service (1998) concluded that potential indirect threats to blue whales include vessel collisions, entanglement in fishing gear, low frequency noise disturbance and reduction in prey species (for example, Euphausiids) due to habitat degradation. These are the potential sources of mortality and other factors that could be influencing the recovery of this species.

V.C.5.f(3)(d)3) Cumulative Effects on Fin Whales

Most stocks of fin whales were depleted by commercial whaling (Reeves, Silber, and Payne, 1998) beginning in the second half of the mid-1800's (Schmitt, de Jong, and Winter, 1980; Reeves and Barto, 1985). In the 1900's, hunting for fin whales continued in all oceans for about 75 years (Reeves et al., 1998) (see information on whaling level in the previous section on current and historic abundance). It is likely that reports of Soviet takes of fin whales in the North Pacific are unreliable (Reeves, Silber, and Payne, 1998), because evidence indicates the Soviets over-reported fin whale catches by about 1,200, presumably to hide takes of species such as right whales and other protected species (Doroshenko, 2000). In 1965, Nemoto and Kasuya (1965) reported that fin and sei whales were the primary species taken in the Gulf of Alaska during Japanese commercial whaling in recent catches. Figure 1 of that report documents that in 1963, more than 150 fin whales were taken just south of the Kenai Peninsula. Other areas of high take in 1963 were southeast Alaska especially and areas offshore between Prince William Sound and Glacier Bay. Multiple smaller groups of fin whales were taken offshore of areas south of Kodiak Island and the Alaska Peninsula to Unimak Pass, and large numbers were taken throughout the northern Gulf in an area bounded on the south at approximately 53° N. Latitude. Legal commercial hunting ended in the North Pacific in 1976.

There is no evidence of subsistence take of fin whales in the Northeast Pacific (Angliss, DeMaster, and Lopez, 2001; Angliss and Lodge, 2002).

There is little information about natural causes of mortality (Perry, DeMaster, and Silber, 1999d). In 2002, the National Marine Fisheries Service summarized that "There are no known habitat issues that are of particular concern for this stock" (Angliss, DeMaster, and Lopez, 2001; Angliss and Lodge, 2002). Documented human-caused mortality of fin whales in the North Pacific since the cessation of whaling is low. Perry, DeMaster, and Silber (1999d:51) list the following factors possibly influencing the status of fin whales in the North Pacific: Offshore oil and gas development as a "Present or threatened destruction or modification of habitat" and vessel collisions as an "Other natural or man-made factor." The possible influences of disease or predation and of overutilization are listed as "Unknown." Documented fishery interaction rates are low in the North Pacific. However, the only information available for many fisheries in the Gulf of Alaska comes from self reporting by individual fishers. Such data likely are biased downwards. Based on the death in 1999 of a fin whale incidental to the Bering Sea/Aleutian Island groundfish fishery, National Marine Fisheries Service estimates three mortalities in 1999 and an average yearly take of 0.6 [coefficent of variation (CV) = 1]) between 1995 and 1999 (Angliss and Lodge, 2002). In the North Atlantic, nine entanglements were recorded in the National Marine Fisheries Service Northeast Regional entanglement database between 1975 and 1992 (Blaylock et al., 1995) and three other instances indicating entanglement were recorded between 1992 and 1996 (Waring, et al., 1998). In the North Atlantic, there is concern about the potential impact of overexploitation of certain fish stocks on fin whales (Perry, DeMaster, and Silber, 1999d). Reported instances of fin whale deaths due to vessel strikes are low. One fin whale death due to vessel strike was reported in the North Pacific in 1991 (Perry, DeMaster, and Silber, 1999d), and a fin whale was struck by a vessel in Uyak Bay in 2000. In the North Atlantic, there is documented effect on behavior from whale watching and other recreational boat encounters and from commercial-vessel traffic (for example, Stone et al., 1992) and also evidence of habituation to increased boat traffic (Watkins, 1986). Perry, DeMaster, and Silber (1999d) summarized that noise from seismic exploration did not appear to affect fin whales in detectable ways (McDonald et al., 1993).

V.C.5.f(2f(3)(d)4) Cumulative Effects on Humpback Whales

Commercial whale hunting resulted in the depletion and endangerment of humpback whales. Unregulated hunting legally ended in the North Pacific in 1966. The National Marine Fisheries Service (1991a) reports that entrapment and entanglement in active fishing gear (O'Hara, Atkins, Ludicello, 1986) as the most frequently identified source of human-caused injury or mortality to humpback whales. Entrapment and entanglement have been documented in Alaska (for example, von Zeigesar, 1984 cited in von Ziegesar, Miller, and Dahlheim, 1994). From 1984-1989, 21 humpbacks are known to have become entangled in gear in Alaska. Gear types included gill nets, seine nets, long lines or buoy lines, and unidentified gear.

Vessel collision also is of concern for humpbacks. The National Marine Fisheries Service (1991a) reported that at least five photographed humpbacks in southeastern Alaska had gashes and dents probably caused by vessel strikes.

The National Marine Fisheries Service (1991a) also lists noise and disturbance from whale-watching boats; industrial activities; and ships, boats, and aircraft as causes of concern for humpback whales. The impact of pollution on humpbacks is not known. Habitat degradation also could occur due to coastal development. In Hawaii humpback habitat, harbor and boat-ramp construction, vessel moorings, water sports, increased boat traffic, dumping of raw sewage by boats, runoff and overflow of sewage from land sites, and agriculture and associated runoff are all potential causes of habitat degradation.

V.C.5.f(3)(d)5) Cumulative Effects on North Pacific Right Whales

It is not know what natural or human-related factors currently might be negatively impacting the North Pacific right whales. Thus, it also is difficult to determine probable future human-caused impacts on this species. The National Marine Fisheries Service (1991a) discussed the possible impacts of the following human-related factors on North Pacific right whales: (1) ship collisions; (2) disturbance from vessels; (3) entrapment and entanglement in fishing gear; (3) habitat degradation; and (4) hunting. However, the current rarity of this species, and especially of the stock, makes it difficult or impossible to evaluate causes of mortality or injury in the stock (Angliss and Lodge, 2002) other than the historic and recent impacts of whaling (a form of hunting). However, no legal whaling will occur on this species in the foreseeable future.

There is no evidence of (1) pollution-related mortality or injury to this species, including mortality or injury due to oil spills; (2) adverse impacts of previous OCS or State oil and gas exploration or development on this population stock; and (3) Native take of this species. There is no information on incidence of disease, levels of contaminants, impacts of noise, or other potential threats to eastern North Pacific North Pacific right whales.

In the North Atlantic and in the Southern Hemisphere, entanglement in fishing gear (including gillnets, herring weirs, lobster and crayfish lines) and ship strikes are documented significant sources of mortality to those species of right whale (see the following). These same sources could pose a threat to the similar, slow-swimming, large, North Pacific right whales, particularly if they are inhabiting, or begin to inhabit, areas of the Bering Sea or Gulf of Alaska where high levels of commercial fishing occur or where high levels of ship activity occur (for example, near Dutch Harbor). At present, vessel-related mortality rates for this stock are unknown (Perry, DeMaster, and Silber, 1999c). There is no evidence of fisheries interactions with this stock (Angliss and Lodge, 2002). The present known distribution of this stock of right whales does not overlap with areas where gillnets are used in fishing (M. Payne, cited in Alaska Scientific Review Group, 2001), but discarded or lost gear could affect animals far from the site of net use. There are few data on fishery interactions with North Pacific right whales. The National Marine Fisheries Service (Angliss and Lodge, 2002) reports that only one fishery-related (gillnet entanglement) mortality has been reported for North Pacific right whales, occurring off of the Kamchatka Peninsula in 1989 (Kornev, 1994). No entanglements of right whales have been reported by fishery observers, which are required on many of the large vessels in the Bering Sea (67 *FR* 7662).

In the North Atlantic, "…direct and indirect impacts from human activities-mostly in the form of vessel collisions and entanglement in fishing gear almost certainly have contributed to a lack of recovery…." (National Marine Fisheries Service, 2001:1). Data from the western North Atlantic indicate that fishing entanglement is a significant-enough source of right whales in that area (Kenney and Kraus, 1993) to merit the establishment of Take Reduction Teams charged with development of measures to reduce fishery take. An estimated 57% of right whales in the western North Atlantic have injuries or scars indicative of fishing gear entanglement (Kraus, 1990). An estimated 7% of the known mortality of North Atlantic right whales was due to entanglement in fixed gear (Kenney and Kraus, 1993). In the North Atlantic, ship strikes are the greatest known cause of right whale mortality, accounting for 22% of 27 documented mortalities from 1970-1991 (Perry, DeMaster, and Silber, 1999c).

Perry, DeMaster, and Silber (1999c:20) concluded "…the primary factor influencing…recovery…" (of North Atlantic right whales) "…involves their occurrence in coastal habitats. This…places them in direct contact with shipping traffic, fishery operations, coastal oil and gas development, and other human activities."

Perry, DeMaster, and Silber (1999c) also examined the five factors referred to in the ESA as factors that possibly could be influencing the recovery of North Pacific right whales. They stated that the possible influence of overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; and inadequacy of existing regulatory mechanisms all are unknown. With respect to the present or threatened destruction or modification of habitat in the North Pacific, they specified offshore oil and gas development and refer to noise disturbance and oil spills as examples of negative factors associated with such activity. However, they provide no specifics of any oil spill or OCS oil- and gas-related disturbance, injury, or mortality. Lastly, they listed entanglement in fishing gear (for example, drift gillnets) as other natural or manmade factors that could be influencing recovery in the North Pacific.

V.C.5.f(3)(d)6) Cumulative Effects on Sei Whales

Because no reliable abundance estimates are available for this stock of sei whales, Potential Biological Removal levels cannot be calculated (Carretta et al., 2001). Thus, it is problematic to assess the significance of any potential current or future level of mortality from other human causes or the cumulative effect of the Proposed Action.

Bering Sea/Aleutian Island and Gulf of Alaska groundfish trawl, longline, and pot fisheries were monitored for incidental take in 1990-1997, but no mortalities or serious injuries of sei whales were observed (Hill and DeMaster, 1999e). Total estimated fishery mortality for the eastern North Pacific Stock of sei whales is zero (Carretta et al., 2001).

V.C.5.f(3)(d)7) Cumulative Effects on Sperm Whales

Human hunting led to the current endangered status of sperm whales; 258,000 sperm whales were taken by commercial whalers in the North Pacific between 1947 and 1987 (C. Allison, pers. commun., cited in Angliss, DeMaster, and Lopez, 2001). This number is considered an underestimate due to underreporting by the U.S.S.R. between 1949 and 1971 by 60% (Brownell, Yablokov, and Zemsky, 1998). New information suggests Japanese land-based whaling operations also under-reported during post-World War II era (Kasuya, 1998). The Japanese officially stopped catching sperm whales in the North Pacific in 1988 (Reeves and Whitehead, 1997).

There are six commercial fisheries operating within the range of the North Pacific stock. No mortalities observed by National Marine Fisheries Service fisheries observers or reported by self-reported fisheries (the latter being incomplete and therefore unreliable) (Angliss, DeMaster, and Lopez, 2001). "…based on the lack of reported mortalities (by fishermen), the estimated annual mortality rate incidental to commercial fisheries is zero. As a result, the annual human-caused mortality is considered to be insignificant and approaching a zero mortality and serious injury rate" (Angliss, DeMaster, and Lopez, 2001).

There have never been reports of subsistence take of sperm whales (Rice, 1989).

V.C.5.f(3)(e) Cumulative Effects on Other Marine Mammals

V.C.5.f(3)(e)1) Cumulative Effects on Steller Sea Lions

In the absence of a very large oil spill, we would expect any incremental effects attributable to the proposed Cook Inlet sales to be insignificant for the eastern population stock of Steller's sea lions. The primary potential for significant incremental contributions to cumulative adverse effects on Steller's sea lions from routine operations could result from incremental increases in noise and disturbance at key terrestrial and foraging critical and other habitats of the western population stock if such incremental increase resulted in Steller sea lions avoiding important feeding habitats or resulted in direct mortality. Any large displacement, particularly of juvenile, western population stock Steller sea lions from important foraging habitats could result in a significant cumulative adverse effect on this population stock. Any such displacement from marine critical habitats could result in a significant adverse cumulative effect on the designated critical habitat. Displacement from important feeding habitats would not have to be years in duration to have a potentially significant cumulative effect, especially if juveniles from this stock were displaced. Such a cumulative effect is considered unlikely from routine operations, unless Steller sea lions avoided important foraging areas due to noise or other disturbing activities that occurred within or very near their critical habitats. Any disturbance of the western population stock of Steller lions at their terrestrial critical habitats that resulted in mortality (for example, due to trampling) could result in a potentially significant negative adverse effect on both the western population stock of Steller sea lions and on that critical habitat. Any potential increase in mortality of Steller sea lion prey species in sea lion critical habitat that resulted in a large decrease in prey available to the western stock of Steller sea lions could result in potentially significant cumulative effect on both the stock and on the critical habitat. Such a significant effect on prey probably is possible only in the unlikely event of a large or very large oil spill that contacted critical habitat or other important feeding areas and reduced availability of Steller sea lion prey. Such a large or very large spill also conceivably could result in a significant cumulative effect, if it resulted in the exposure to large amounts of fresh crude oil by Steller sea lions, particularly if it resulted in the oiling of pups.

The National Marine Fisheries Service (2001b) presented information and discussion on past external adverse impacts on Steller sea lions in Appendix J. Significant sources of past effects included take in foreign fisheries, take in other fisheries, and commercial harvest. It is suspected that decreases in population size before the 1960's were likely due to human exploitation of this species (National Research Council, Committee on the Bering Sea Ecosystem, 1996).

The National Marine Fisheries Service (2001b) has concluded that there is some concern for the take of Steller sea lions due to encroachment by humans near critical terrestrial habitat sites (for example, rookeries, haulouts) for viewing, research, or intentional harassment.

V.C.5.f(3)(e)1)a) Marine Oil Spills

Because of inconclusive or inadequate studies following previous oil spills in the region, we cannot confidently evaluate the cumulative impacts of oil spills on sea lions. As summarized in the discussion of the potential impacts of a very large spill, and of the potential effects related to development and production, some Steller sea lion haulouts were directly in the plume of oil spilled in Prince William Sound due to the grounding of the *Exxon Valdez*. When oil exited the Sound, it passed by rookery sites in the Barren Islands and haulouts and rookeries farther west. Calkins et al. (1994) concluded that none of their data provided conclusive evidence of an effect of the *Exxon Valdez* oil spill on Steller sea lions. The National Marine Fisheries Service (2002:4-212) concluded that "…insufficient data exists to determine the overall impact of the spill on the population." In March 1970, two dead and oiled sea lions were found on Long Island in Chiniak Bay on the eastern side of the Kodiak Archipelago following a large oil spill that most likely resulted from the release of oil from tanker "slops" and/or ballast waters at sea. This spill resulted in substantial amounts of oil being spread on long distances of rugged coastline in the Kodiak area. "Numerous seals and sea lions covered with oil have been reported by commercial hunters" (Federal Water Pollution Control Administration (1970). However, due to inadequate prespill and postspill data, no estimates of damage to sea lions or other marine mammals were made.

V.C.5.f(3)(e)1)b) Entanglement

The National Marine Fisheries Service (2002:4-212) concluded that "Entanglement in marine debris is also a source of mortality with an estimated 100 Steller sea lions killed each year." However, the National Marine Fisheries Service (2002:4-213) also concluded that the frequencies at which sea lions entangle in derelict fishing gear or other materials "…seems to occur at frequencies that do not have significant effects upon the population."

V.C.5.f(3)(e)1)c) Native Take

Based on village interviews, Wolfe and Hutchinson-Scarbrough (1999) reported estimated subsistence takes of Steller sea lions for subsistence by Alaskan Natives between 1992 and 1998, inclusive. In 1998, they estimated that 178 Steller sea lions were taken. The associated 95% confidence interval was 137-257 sea lions. Of the take, 26.4% (47 sea lions) were struck and lost and 73.6 % (131) were harvested. Eighteen of sixty-two surveyed communities reported taking sea lions. More males were reported taken than females (6.6:1), and more adults (48.2%) were reported taken than juveniles (33%) or pups (18.4 %).

The numbers of sea lions taken in previous years were as follows: 1992, 549; 1993, 487; 1994, 416; 1995, 339; 1996, 186; and 1997, 164. Most of the animals are taken by Aleut hunters from the range of the western U.S. stock in the Aleutian Islands and the Pribilof Islands.

V.C.5.f(3)(e)1)d) Illegal Intentional Killing

The National Marine Fisheries Service (2002) concluded that Steller sea lions were intentionally shot in several nearshore fisheries before and after the passage of the Marine Mammal Protection Act in 1972. Such shooting continued until at least the early 1990’s, when sea lions were listed as threatened under the ESA and a ban on shooting at Steller sea lions was enacted (Hill and DeMaster, 1999). Loughlin and York (2001, unpublished manuscript) conclude that the current rate of mortality from this cause is difficult to evaluate. However, it is clear that illegal shooting still occurs. They report that estimates (based on Trites and Larkin, 1992, cited in Loughlin and York, 2001, unpublished manuscript) of shooting-related mortality range from 1,180 in 1985 to zero. Loughlin and York (2001, unpublished manuscript) guessed (their term) that the annual mortality is at least 50 animals/year.

V.C.5.f(3)(e)1)e) Incidental Take in Commercial Fisheries

There have been substantial negative impacts on Steller sea lions from take in fisheries since the 1960’s. Perez and Loughlin (1991) concluded that over 20,000 Steller sea lions were likely killed in foreign Joint Venture fisheries from 1966-1988. Fisheries such as State-managed drift- and set-gillnet fisheries contributed to the take, although this take is not well defined. Based on data indicating that Steller sea lions rarely travel beyond the U.S. Exclusive Economic Zone, Hill and De Master (1999) concluded that current levels of take of this species in foreign fisheries are relatively low. The documented take in other fisheries is also low. Hill and DeMaster (1999) estimated that 14.5 sea lions per year were taken incidental to the Prince William Sound drift-gillnet fishery for 1990 and 1990. Self-reported levels of take from six unobserved fisheries were about 6.1 animals per year. Hill and DeMaster (1999) estimated that the total take from fisheries, including groundfish fisheries, is about 30 animals per year. However, it must be stressed that most fisheries-interactions studies have been small in scope and short in duration. Existing data are insufficient to confidently estimate levels of fishery take.

While referring to takes of cetaceans and pinnipeds in set-gillnet and driftnet fisheries, Read and Wade (2000:933) point out the following: “Because so few fisheries have been monitored in Alaska, we do not know the magnitude of these takes. Therefore, although only a few stocks in Alaska had takes greater than Potential Biological Removal, this result should be considered uncertain pending observations of the many category II gill-net fisheries in that area.”

When the annual subsistence harvest is combined with the annual take in fisheries, the total take is about 88% of the Potential Biological Removal of 234 animals for the western stock U.S. stock of Steller sea lions.

V.C.5.f(3)(e)1)f) Fishery Impacts on Effects on Prey Abundance

Both State run (for example, salmon and herring) domestic fisheries, as well as foreign fisheries likely have had negative impacts on the abundance and availability of prey for Steller sea lions (National Marine Fisheries Service, 2002). Recent fishery-management plans have attempted to address this issue by prohibiting types of fishing for Steller sea lion prey species in certain areas. This issue is discussed in great detail by the National Marine Fisheries Service (2001b).

V.C.5.f(3)(e)1)g) Human Settlement and Disturbance Related Threats

Many of the human settlement and human disturbance-related issues detailed in Section V.C.5.f(3)(e)3)f) for sea otters also pose potential threats to sea lions. Both share much of the same range, and as carnivores are susceptible to some of the same threats. For example, there is risk to Steller sea lions from introduced disease, due to increasing levels of human settlements and concomitant increases in the presence of species, such as domestic dogs and cats, both of which can serve as reservoirs of disease (for example, canine distemper [dogs] and protozoal [*Toxoplasma gondii*] infection capable of causing encephalitis [cats]), which potentially can be harmful to Steller sea lions.

V.C.5.f(3)(e)2) Cumulative Effects on Designated Critical Habitat of Steller Sea Lions

The National Marine Fisheries Service (2001b) has concluded that, in Alaska, there does not appear to have been loss of terrestrial habitat critical to Steller sea lion survival and recovery due to construction or other physical degradation and that such habitat appears to be in good physical condition. Human encroachment on or near terrestrial critical habitat site (for example, rookeries or haulouts, or both) for research, viewing and intentional harassment (National Marine Fisheries Service, 2001b) may be compromising the value of some sites for Steller sea lion survival and/or recovery.

The National Marine Fisheries Service (2001b) states that previous biological opinions concluded that the availability of important Steller sea lion fish-prey species was reduced by groundfish harvests in designated critical habitats.

The National Research Council (National Research Council, Committee on the Bering Sea Ecosystem, 1996) suggested that long-term climate-induced changes in the distribution and abundance of Steller sea lion prey might have contributed to the steep declines that have occurred during the past few decades in Steller sea lion abundance. Anderson and Piatt (1999), and Merrick, Loughlin, and Calkins (1987) suggested that declines in food availability and in abundance of high-quality forage fish led to food-related stress in several marine mammals.

V.C.5.f(3)(e)3) Cumulative Effects on the Southwest Alaska Stock of Sea Otters

Multiple other human actions have had, and are likely to continue to have, potentially negative effects on the southwest Alaska stock of sea otters. These include mortality due to marine oil spills, take by Alaska Natives for subsistence and handicrafts, illegal intentional take, incidental take in fisheries, exposure to environmental contaminants, habitat degradation and loss, heightened risk of disease, and disturbance.

V.C.5.f(3)(e)3)a) Commercial Hunting

Sea otters were nearly exterminated throughout their entire range due to commercial overhunting from the mid-1700's through the beginning of the 1900's (for example, Ogden, 1941; Lensink, 1962; Miller and Miller, 1967; Kenyon, 1969; Simenstad, Estes, and Kenyon, 1978; Rotterman and Simon-Jackson, 1988).

V.C.5.f(3)(e)3)b) Marine Oil Spills

The southwest stock of sea otters has been, and again could be, adversely affected by oil contamination, primarily due to oil spills associated with the grounding or sinking of vessels containing large amounts of petroleum products or other release oil from such vessels. As described in Section IV.F on the effects of a very large spill, large numbers of sea otters were killed following the *Exxon Valdez* oil spill (see details provided in that section). While most of the sea otters killed as a result of that spill were from the Southcentral Alaska stock of sea otters, sea otters from the Southwest Alaska stock also may have been negatively affected. Sea otters are highly vulnerable to oil contamination in their habitat. As summarized elsewhere in this document, significant spills of oil and other petroleum products have occurred in the recent past in Cook Inlet, near the Aleutian Islands, and in other areas where the spilled oil affected, or had the potential to affect, sea otters, their habitat, and their prey. For example, in March 1970, there was a large oil spill, presumably from "slops" and possibly ballast water released at sea from tankers, which contaminated large areas of marine habitat and coastline on the far north and eastern portions of the Kodiak Archipelago. At the time of the spill, field teams estimated that 1,000 miles of coastline were "involved" in the incident. While the report does not state so directly, this amount of coastline probably refers to an estimate of the amount of coastline that was oiled, since it appears shortly after a statement about a preliminary estimate of 500 miles of oiled coastline. Although numerous oiled seals and oiled birds were observed both dead and alive, records only document the recovery of one dead oiled sea otter pup in Mill Bay in March 1980. However, the report (Federal Water Pollution Control Administration, 1970) concludes that "…it is felt that a number of sea otters must have been affected."

Although no spill of the magnitude of the *Exxon Valdez* oil spill have occurred in the Aleutian Islands, Kenyon (1969) suggested that mass mortality of sea otters may have occurred after boat sinkings in the Aleutians. In the Aleutians, the highest risk probably is associated with the sinking and/or grounding of ships (for example, freighters or tankers) carrying large amounts of petroleum products. Groundings or sinkings of ships with sufficient fuel to endanger otters in a local area appear to happen rather regularly in the Aleutians.

V.C.5.f(3)(e)3)c) Native Take

Prior to commercial exploitation in the 1700's, hunting of sea otters by aboriginal people may have limited sea otter populations, particularly in the vicinity of village sites (Simenstad, Estes, and Kenyon, 1978). Simon-Jackson (1988:4) concluded: "[W]ith modern transportation and weapons, an unrestrained Native harvest could endanger sea otters in localized areas of Alaska in a very short time. Sea otters are extremely vulnerable to harvest."

Amendments in 1981 to the Marine Mammal Protection Act authorized the Fish and Wildlife Service and the National Marine Fisheries Service to require marking, tagging and reporting of marine mammals, including sea otters, taken for subsistence and/or the making of handicrafts. The Fish and Wildlife Service promulgated regulations for marking, tagging, and reporting on June 28, 1988. These regulations specify that Alaskan Natives must report the take of a sea otter, polar bear, or walrus to the Fish and Wildlife Service within 30 days of taking, and they must also present pelts and other specified parts to be marked and tagged (Marine Mammal Commission, 2000). The Fish and Wildlife Service works closely with Alaskan Native organizations on the marking, tagging, and reporting program. As detailed elsewhere, between 1988 and 1999, more than 6,800 (to 1999) sea otters were presented for tagging. However, the Fish and Wildlife Service (Stephensen, Cramer, and Burn, 1994) points out that "…lacking independent harvest estimates for sea otter…, the true level of the marking, tagging, and reporting program compliance may never be known." Hence, the accuracy of estimates of Alaskan Native take of sea otters from the marking, tagging, and reporting program is not known and the possible impacts of such take on the decline, thus, are difficult to assess. In comments on the draft EIS), the Fish and Wildlife Service stated that their Marking, Tagging and Reporting staff believe that tagging compliance for sea otters is at least 90%, both because it is illegal for commercial tanneries to accept untagged hides (thus hunters have incentive to tag their sea otter hides) and based on annual interviews by village resident taggers with other village residents. There are no data available that would permit evaluation of this belief.

Simon-Jackson (1987) summarized levels of reported take between 1982 and 1986, inclusive: 1982, 4; 1983, 31; 1984, 74; 1985, 385; and 1986, 555. Simon-Jackson (1987:1) indicated that she did not have confidence that the reported levels were likely to be accurate. Data summarized in the Marine Mammal Commission's 1999 Annual Report to Congress (2000:84) indicates that the total number of sea otter pelts presented for tagging from all locations in Alaska were as follows: 1990, 166; 1991, 231; 1992, 637; 1993, 1,248; 1994, 835; 1995, 629; 1996, 608: 1997, 755; and 1998, 844).

Depending on exactly how take is distributed geographically, the documented levels of take by Alaskan Natives over the past 15 years (see Section V.C.5.f(3)(e)3)c)) could significantly affect the demography, and the local distribution and abundance, of some populations of sea otters, especially those near hunting centers. Between 1988 and 1999, a total of 6,826 otters have been tagged from Alaskan water (USDOI, Fish and Wildlife Service, 2000b). Of these, 3,136 were from southeast Alaska (USDOI, Fish and Wildlife Service, 2000b, 1994:7), an area with population estimate of 7,430 (USDOI, Fish and Wildlife Service, 1995a). 1,924 were from four communities in Prince William Sound (Fish and Wildlife Service, 2000a), an area with a population size estimated variously as 6,200 animals, exclusive of Orca Inlet (USDOI, Fish and Wildlife Service, 1994) to 14,352 (USDOI, Fish and Wildlife Service, 1995a). The Southcentral Alaska stock of sea otters is reported by the *Exxon Valdez* Trustee Council as not yet fully recovered from the 1989 *Exxon Valdez* oil spill.

Recently reported levels of take of sea otters by villages within the range of the federally designated southwest Alaska stock are given in Table III.B-13. The highest levels of reported take for this stock are in the Kodiak Archipelago. Reported levels of take of sea otters by Alaska Natives in the Aleutian Islands, and in adjacent regions, under the exemption for subsistence and/or handicrafts, are low (Table III.B-13). In addition to those levels reported from areas within the normal range of this designated stock, sea otters also have been tagged in communities in the central to northeast Bering Sea, areas where sea otters normally do not reside, including Bethel and Shishmaref (Table III.B-13). It is likely that some of these otters were taken in the Aleutians, from the population north of Unimak Island and the Alaska Peninsula, and/or from populations south of the Alaska Peninsula. If the levels of Native take that are reported are accurate, such take would not contribute significantly to the decline of the southwest Alaska stock of sea otters.

Additionally, sea otters also are taken by hunters from other regions of Cook Inlet, such as Anchorage. Information about the location of the take of such hunters is not available (i.e., it is not known whether they harvested sea otters on the west or the east side of Cook Inlet). The total reported takes from 1988 through 2002 for locations within Cook Inlet and its bays, but outside the range of the putative southwest Alaska stock of sea otters, are as follows: Anchorage, 376; Homer, 128; Kenai, 68; Nanwalek, 39; Port Graham, 201; and Seldovia, 80.

The historical record demonstrates the extreme vulnerability of the sea otter to overharvest (even with the relatively primitive weaponry and marine transportation technology of the 18th and 19th centuries). The accuracy of reported levels of take is unknown (Stephensen, Cramer, and Burn, 1994). Relatedly, reported takes of sea otters Statewide rose dramatically in the late 1980's and mid-1990's. Thus, overharvest must be considered a potential current and future threat to the southwest Alaska stock of sea otters.

V.C.5.f(3)(e)3)d) Illegal Intentional Killing

Levels of illegal intentional killing of sea otters in Alaska are unknown, therefore, so is the significance of such take. Such mortality, including deaths due to shooting and skull crushing, has been documented in the past, primarily during the course of research into sea otter-commercial fishery interactions (Rotterman and Simon-Jackson, 1988; Wynne, 1989) (see the following). At least in the mid- to late 1980s, there was considerable concern about the impacts of sea otters on shellfish populations used by human residents of Alaska and related antagonism towards the species in many coastal communities (Simon-Jackson, 1987; Rotterman and Simon-Jackson, 1988).

V.C.5.f(3)(e)3)e) Incidental Take in Commercial Fisheries

Documented impacts on sea otters in Alaska related to commercial fisheries include capture incidental to fishing activity (Simon-Jackson, 1985; Rotterman and Simon-Jackson, 1988; Wynne, 1990; Wynne, Hicks, and Munro, 1991); death in nets (Simon-Jackson, 1985; Rotterman and Simon-Jackson, 1988); and displacement from important habitat due to disturbance (Garshelis and Garshelis, 1984). For at least 3 years in the mid-1980's to late 1980's, dead sea otters, including some that had been shot or with crushed heads, were found by Fish and Wildlife Service and other biologists on beaches adjacent to areas of intense fishing activity (Simon-Jackson, 1986; Rotterman and Simon-Jackson, 1988; Wynne, 1990), indicating intentional killing associated with fishing activity. For example, of the sea otters found on barrier beaches of the Copper River Delta in 1988 and 1989 after fishing openings, and for which a cause of death could be determined (no cause of death was determined for 20 out of 38 individuals), approximately 44% (8 out of 18) appeared to have died from severe head injury and about 11% were shot (2 out of 18) (calculations based on data in Wynne, 1990).

Most of the sea otter/fishery interactions in Alaska have been associated with set- and drift-gillnet fisheries (Simon-Jackson, 1985; Wynne, 1990; Wynne, Hicks, and Munro, 1991). Monnett (1988:69) reported that "entanglement in commercial fishing gear" (in this case drift gillnets) "was a significant problem and a cause of deaths to the sea otters in this study" of radio-instrumented sea otters in Prince William Sound in the mid-1980's. In 1990, 92 observations of sea otters within 10 meters ("encounters") of an active driftnet were recorded for the Prince William Sound driftnet fishery, of which 8 were observed to entangle. Ten and eight encounters were documented that year for the Prince William Sound setnet and South Unimak Island driftnet fisheries, respectively, but no entanglements were reported for these latter two fisheries. However, there is documentation of the take of sea otters in seines, in crab pots (Simon-Jackson, 1985), in the black cod single-pot fishery (USDOI, Fish and Wildlife Service, 1995a) (two taken), and in trawl fisheries (National Marine Fisheries Service).

During the summers of 1999 and 2000, 56 interactions, but no entanglements or mortalities, of sea otters with nets were observed by biologists observing Cook Inlet drift- and set-gillnet salmon fisheries (Merklein, Fadely, and van Atten, unpublished presentation and data, provided by Fadely, 2003, pers. commun.). With respect to overall marine mammal fishery interactions in this area, these authors, in preliminary reporting of the results of these studies, concluded that "In contrast to many gillnet fisheries, these appear to have an infrequent marine mammal incidental catch rate."

The magnitude of sea otter take associated with commercial fisheries in Alaska over a period of years and, hence, the significance, of this take throughout Alaska is unknown. This is because there have been few studies focused on the problem, because those that have occurred have been of short duration, and because studies may not have sampled periods of peak interactions. As noted previously, while referring to takes of cetaceans and pinnipeds in set and drift gillnet fisheries, Read and Wade (2000:933) pointed out the following:

> Because so few fisheries have been monitored in Alaska, we do not know the magnitude of these takes. Therefore, although only a few stocks in Alaska had takes greater than PBR [Potential Biological Removal], this result should be considered uncertain pending observations of the many category II gill-net fisheries in that area.

The same is true of takes of sea otters in fisheries. Respondents to Simon-Jackson's (1985) questionnaire reported taking 72 sea otters incidental to fishing between 1980 and 1984, with 21% of those who responded reported having done so.

Thus, sea otters are taken incidental to drift- and set-gillnet fisheries in parts of Alaska including the Alaska Peninsula, Kodiak, and Prince William Sound (Simon-Jackson, 1985; Rotterman and Simon-Jackson, 1988; Wynne, 1989, 1990; Wynne, Hicks, and Munro, 1991). There are no commercial gillnet fisheries in the Aleutian Islands west of Unimak Pass, a large part of the range of the southwest Alaska stock. Fishers' responses to questionnaires in the 1980's documented the take of sea otters in gillnets in the fishery just south of Unimak Island. During the 1990 south Unimak drift fishery, eight sea otters were observed within 10 meters of nets, but none were observed to become entangled (Wynne, Hicks, and Munro, 1991). While documented levels of interaction in that gillnet fishery were low (Wynne, Hicks, and Munro, 1991), monitoring has been insufficient to adequately assess levels of take. More pertinent to sea otters in the Aleutian Islands west of Unimak Pass is that sea otters also have been reported taken in crab pots (two otters taken out of 19 crab fishermen responding to questionnaire) (Simon-Jackson, 1985) and in the Bering Sea Aleutian Island groundfish trawl fishery. However, documented instances of take are low. While monitoring of the groundfish trawlfishery is undertaken as part of the National Marine Fisheries Service National Observer Program to document bycatch of nontarget fish species, marine mammals taken in the fishery are documented by observers.

Based on 143 fishers' responses to a questionnaire about sea otter-fishery interactions in Alaska, the Aleutians, the Alaska Peninsula, the Kodiak Archipelago, and Prince William Sound were the areas where sea otter-fishery interactions were the most acute (Rotterman and Simon-Jackson, 1988). In 1985, sea otter populations in the Adak region, and the Peninsula/Aleutians Region were perceived to be "high" by most fishers' respondents to a Fish and Wildlife Service questionnaire (Simon-Jackson, 1985). Two respondents Statewide reported fishers shooting sea otters to protect their livelihoods. Simon-Jackson (1985) identified the Peninsula/Aleutians area as a sea otter-fishery "conflict area." She concluded that, Statewide, "(P)erceptions of the way sea otters and fishermen come into conflict are mainly through direct competition for shellfish stocks" (Simon-Jackson, 1985:14). It is unknown whether, 17 years later, this perception is still as strong and related animosity towards the sea otter as high.

Sea otters are taken incidental to fisheries in the Aleutian Islands, the Alaska Peninsula, and the Kodiak Archipelago, and fishers previously have identified these areas as ones in which there are problems with sea otters. However, existing data indicate incidental levels of take are low. There are no data on which to estimate intentional illegal take associated with fisheries in the Aleutians, but such take has been documented elsewhere in Alaska. There also are no data to evaluate the possible impacts of fisheries in the Aleutian Islands on the habitat use of sea otters due to disturbance from fishing-vessel traffic during transit or during fishing activity itself. Because sea otters have been taken in the fisheries, there is clearly some overlap between sea otter habitat use and fishing areas.

Fishery-related disturbance probably is most serious in the eastern portion of the range, near Kodiak, the Alaska Peninsula, and Unalaska.

V.C.5.f(3)(e)3)f) Human Settlement and Disturbance-Related Threats

There are scattered human settlements in the range of the southwest Alaska stock of sea otter. Some of these towns are active fishing centers (for example, Kodiak, Dutch Harbor). The port at Dutch Harbor on

Amaknak Island is the commercial center of the Aleutians and "…is the busiest commercial fishing port in the Nation and one of the world's major fishing centers (Campbell, 1995:74). Most of the fishing is for crab and bottomfish, such as pollock, halibut, and cod. With such development comes both land- and vessel-related pollution, including, but not limited to sewage discharge from towns and vessels into marine waters; petroleum pollution related to runoff and automobile accidents (vehicles regularly are reported landing in the marine waters near Dutch Harbor); vessel operation, fueling, and sinkings; and marine debris (for example, nets, plastics, and garbage) associated with fishing activity. Disturbance from boat traffic can alter sea otter habitat use. Boats often seek shelter in protected bays in the Aleutians during the frequent storms in the region, with accompanying disturbance to resident otters, potential for pollution of important habitat, and increased risk of intentional take by fishers.

In 1995, Campbell (1995:82) reported that the Trident Seafood shore-based processing plant is "…one of the biggest volume processors in Alaska, handling cod, pollock, crab and halibut delivered by a fleet of boats. It employs about 800…during peak season." More "than 300 boats, mostly out of Seattle…" deliver to processors in the bay (Campbell, 1995:82). The Port of Dutch Harbor has more than 4,3000 residents, and the city has estimated that it serves "upwards of 15,000 people each year, counting seasonal factory workers and…fishermen" (Campbell, 1995:84).

There also is risk to sea otters from disease introduction from animal species associated with humans, including cats (see discussion of disease in the affected environment section), dogs, fox, sheep, cattle, reindeer, horses, and other mammals. This risk is highest in the eastern end of the range, near Cook Inlet, Kodiak, Umnak, and Unalaska islands. For example, near Nikolski, a Canadian ranching company bought "…1,100 cattle, 500 sheep and 50 horses…, with [also] 3,000 head of livestock on Umnak and Unalaska Islands and a planned slaughterhouse on Umnak's east end" (Campbell, 1995:89).

V.C.5.f(3)(e)3)g) Tourism

Within the range of the southwest Alaska sea otter stock, tourism is an important and growing part of local economies. For example, in 1993, Unisea opened the Grand Aleutian Hotel on Margaret Bay in the Aleutians. "With increased accommodations, organized land and sea tours have been developed…that focus on bird- and marine-mammal watching,…fishing…" and other activities (Campbell, 1995:75). Because sea otters, especially females with pups, are sensitive to disturbance, tourism-related boats or ships can alter sea otter habitat use. Additional risks include habitat degradation through vessel-related pollution. However, at present tourism probably is not significantly impacting this designated stock of sea otters, except possibly in localized areas.

V.C.5.f(3)(e)3)h) Environmental Contaminants

Exposure to persistent organochlorines, such as polychlorinated biphenyls, polychlorinated dibenzo-p-dioxins, and other related compounds, threatens sea otters within the range of the designated Southwest Alaska stock and could be contributing to their apparent decline through negative impacts on reproduction and survival.

Studies published by Federal and other scientists have documented that some organochlorines are substantially elevated in sea otters livers at Adak Island (Bacon et al., 1999; Estes et al., 1997) compared with levels in those from California and especially from southeast Alaska. Average concentrations of polychlorinated biphenyls (quantified as the sum of 48 congeners) in sea otter livers at Adak (309 micrograms per kilogram wet weight) were 38-fold higher than in Southeast Alaska (8 micrograms per kilogram wet weight) and also were higher than levels in California (185 micrograms per kilogram wet weight (Estes et al., 1997). Estes et al. (1997:488) reported that these polychlorinated biphenyl levels were "…similar to those causing reproductive failure in captive mink…." Levels of total DDT concentrations (Aleutians: 36 micrograms per kilogram wet weight, California: 846 micrograms per kilogram wet weight, southeast Alaska: 1 micrograms per kilogram wet weight) and average sums of "other" contaminants (total chlordane, PCDD's, PCDF's, HCB, dieldrin, and tris(4-chlorophenyl)-methanol) (Aleutians: 22 micrograms per kilogram wet weight, California: 43 micrograms per kilogram wet weight, southeast Alaska: 5 micrograms per kilogram wet weight) in livers of sea otters from the Aleutians and from California were elevated relative to those from southeast Alaska (Estes et al., 1997). While further analyses of contaminants in sea otters from 39 sites within the Aleutians have shown that such elevated contaminant levels "…are restricted to a few small areas" (Estes et al., 1998:474, citing findings from Reese, 1998), bald eagle (*Haliaetus leucocephalus*) eggs from Adak, Tanaga, Amchitka, and Kiska Islands in the west central Aleutians also had elevated DDE and polychlorinated biphenyl levels "…establishing the widespread occurrence of these compounds in the Aleutian archipelago…Thus, detrimental impacts of organochlorines on these and other species in the Aleutian Islands are likely" (Estes et al., 1997:488).

Existing data are inadequate to determine whether organochlorines or other pollutants are affecting reproduction in sea otters at contaminated sites. Rates of reproduction and reproductive success have been conducted at only a few locations within the vast area in which the decline in occurring and existing studies are inconclusive. Tinker and Estes (1996) reported that the estimated birth rate of sea otters at Adak was higher than that estimated for other locations, but that this may have resulted from relatively high rates of pup mortality. However, sample sizes for these portions of their study and for the related study of pup survival during dependency were small. Thus, conclusions about the impact of the contamination on sea otter reproduction at Adak are premature. Reported effects of organochlorines are discussed previously in the general section on cumulative effects on marine mammals.

However, as, or possibly more, important than the potential impact(s) of polychlorinated biphenyls on the reproduction of sea otters at some locations in the Aleutians are the potential impacts of polychlorinated biphenyls on survival rates of all age classes of otters, due to their impacts on the immune system and their potential to predispose individuals with high contaminant loads to infectious disease (see discussion above).

Estes et al. (1997) point out that Adak, Amchitka, and Kiska Islands were all sites where past military activity occurred (coinciding with locations of high levels of polychlorinated biphenyls in eagle eggs), whereas DDT's and their metabolites probably have an Asian origin. Iwata et al. (1993) found high levels of residues of HCH's, another class of organochlorines, in surface seawater in samples from the open ocean sampled in the Gulf of Alaska in 1989 and 1990. High levels of organochlorine contamination have been found at numerous former military sites throughout Alaska and elsewhere in the Pacific. In the region of the present decline, there were, until recently, military bases on Shemya (up to 900 personnel) and Adak, a $86 million dollar over-the horizon-radar site on Amchitka, a Loran site on Attu (in the Near Islands (Campbell, 1995), Distant Early Warning Line sites (which also often are associated with organocholorine contamination) on Umnak and Unalaska islands, and possibly other military sites that could have elevated levels of persistent organochlorine and other contaminants. More extensive testing of radiation and other contaminants on Amchitka is occurring. In 1995, the Fish and Wildlife Service "…was coordinating cleanup from military activity on national wildlife refuge lands throughout the Aleutians, including Amchitka…. The naval installation on Adak is already listed …" as a Superfund site and cleanup was underway at Shemya (Campbell, 1995:76). Thus, there are numerous contaminated sites in the Aleutians and, due to the nature of the islands, the possibility for contamination of sea otter habitat is substantial.

V.C.5.f(3)(e)3)i) Research or Public Display

The take of sea otters associated with research or public display probably does not pose a significant threat to sea otters in the Aleutians or elsewhere in the range. While "nearly 150" sea otters from Alaska were taken for public display between 1976 and 1994 and "hundreds more" have been taken during research projects, there "have been no observed effects on sea otter populations from either of these activities" (USDOI, Fish and Wildlife Service, 1995a:3). While exact numbers were not available, few animals have been taken for public display during the last 10 years (USDOI, Fish and Wildlife Service, 2002b). While recent studies of sea otters in Alaska have involved the capture, anesthetizing, and surgical implantation of radio transmitters of studied sea otters, and the acquisition of blood samples and teeth for analyses, data available from studies conducted in Alaska up to 1988 indicated that the rate of accidental death in sea otter research was quite low (Rotterman and Simon-Jackson, 1988). However, the aforementioned activities sometime result in the accidental deaths of captured animals due to factors including drowning, surgical complications, fights between otters, or other unknown factors. Resulting papers and reports often do not provide sufficient data to indicate whether any mortality was associated with research activities. At Adak, 2 out of 44 (4.5%) radio-instrumented otters were not seen again after release (Tinker and Estes, 1996). In California, 53 of the 1,680 (3%) sea otters for which mortality was documented from 1973 through 1983 died or were taken into captivity due to public display, research, or rehabilitation (Ames et al., 1983; J. Ames, cited in Riedman and Estes, 1990).

V.C.5.f(4) Cumulative Effects on Threatened and Endangered Birds

The potential sources of cumulative effects on the threatened and endangered birds in areas within or near Cook Inlet are highly varied due to ecological differences among the species. However, one of the threatened and endangered, or recently delisted, bird species discussed here was documented to have been taken incidental to commercial fisheries in Cook Inlet salmon set- and drift-gillnet fisheries during 1999 and 2000 (Fadely, 2002).

V.C.5.f(4)(a) Cumulative Effects on the Aleutian Canada Goose

The small population of this subspecies that nests on the Semedi Islands is not expected to experience adverse impacts from State lease sales or Cook Inlet spills because of its distance from the site. We have no evidence that members of this subspecies were injured or killed by either the Glacier Bay or the *Exxon Valdez* oil spill. The Proposed Action does not pose a significant threat to the continued existence or the recovery of the short-tailed albatross, even when considered in addition to the impacts of factors of known conservation concern. This is because under any scenario, it is unlikely that an Aleutian Canada goose would be harmed or killed by actions associated with the proposed oil and gas lease sales.

Clearly, the greatest historical threat to the subspecies of goose was the introduction of foxes to its nesting islands. Between 1949 and 2001 (at the time of delisting), foxes had been removed from many (more than 33) islands, but they still remain on many others. The Fish and Wildlife Service has identified the following factors that still could negatively impact the status of Aleutian Canada geese: development and modification of wintering habitat, continued presence of foxes on some nesting islands, disease, predation by bald eagles (on some islands), and possible reduction of genetic variability due to previous severe population reduction and subdivision (Pierson, Pearce, and Talbot, 2000).

Many of the important wintering areas for Aleutian Canada geese are on private land. The major areas used by Semidi Island birds for wintering are on private lands (USDOI, Fish and Wildlife Service, 1991). The Fish and Wildlife Service recently established the Nestucca Bay National Wildlife Refuge in Oregon to protect winter habitat. The Fish and Wildlife Service concludes that "…enough migration and wintering habitat is currently held in public ownership or conservation easements to ensure the continued viability of the subspecies at or near current numbers" (66 *FR* 15651). They also concluded that "The size of the current population and the management practices on currently used goose habitats also lead us to believe that potential threats such as development, variable market conditions, changing agricultural practices, and adverse climatic conditions do not currently threaten the continued survival of the Aleutian Canada goose now or in the foreseeable future" (66 *FR* 15652).

Other, much more minor factors that could result in mortality include shooting, drowning, collisions, predation, and trapping accidents. Predation of eggs or goslings, or both, by ground squirrels, non-native rats, and glaucous-winged gulls (*Larus glaucescens*) may be limiting production in the Semidi Islands (Beyersdorf and Pfaff, 1995; 66 *FR* 15643).

Historically, Aleuts, market hunters, and "sport" hunters harvested Aleutian Canada geese in the Pacific flyway (66 *FR* 15643). Sport hunting limited population growth, when population size already was greatly reduced due to fox predation.

V.C.5.f(4)(b) Cumulative Effects on the Short-Tailed Albatross (Phoebastria albatrus)

V.C.5.f(4)(b)1) Summary

No increase in overall adverse effects is expected to occur because of the Proposed Action. This species rarely, if ever, occurs in the vicinity of existing or proposed State leases. We have no evidence of this species being harmed by previous spills including the *Exxon Valdez* oil spill or the *Glacier Bay* spill.

The Proposed Action does not pose a significant threat to the continued existence or the recovery of the short-tailed albatross, even when considered in addition to the impacts of factors of known conservation concern. This is because under any scenario, it is unlikely that a short-tailed albatross would be harmed or killed by actions associated with the proposed oil and gas lease sales.

V.C.5.f(4)(b)2) Other Sources of Human Impacts

The Fish and Wildlife Service (1999) identified the following potential threats to short-tailed albatross:

- threats to the breeding habitat;
- diseases and parasites;
- predation;
- contaminants; and
- take in fisheries.

The Fish and Wildlife Service has identified the following actions that may require ESA conference or consultation due to the potential for such actions to affect the short-tailed albatross: National Marine Fisheries Service Fishery Management Plans, management practices at Midway Atoll National Wildlife Refuge, permits or authorization for oil tankering within the range of this species, and oil-spill-contingency plans (63 *FR* 58692).

Cochrane and Starfield (1999) identify both volcanic eruption and oil spills near the nesting grounds as potential risk factors to the short-tailed albatross. Important adverse impacts on the Laysan albatross have been documented from factors including incidental fishery take and environmental contamination (Ludvig et al. (1998). Cochrane and Starfield also identify the ingestion of waste plastics picked up at sea as a factor that could cause increasing adverse impacts on albatross. Factors that can negatively impact seabirds in general include oil and fuel spills and fishing gear entanglement. Because we assume that that all oil and gas that eventually could be produced from projects that originate from the proposed sales are for local consumption (there will be no shipment of this oil or gas by tankers), there is no increased risk, and there possibly is a net decreased risk of a tanker-related oil-spill.

V.C.5.f(4)(b)3) Threats to Breeding Habitat

The most significant threat to the long-term recovery and continued existence of Short-tailed albatross is the potential of habitat destruction due to volcanic eruption on the main extant breeding island of Torishima (an active volcano), which could cause significant mortality of adults and chicks and destroy nesting habitat. Eruptions in 1902 and 1939 destroyed much of the original breeding habitat (65 *FR* 46644). Ten years after the 1939 eruption, Austin (1949) reported that the thick reeds that formerly sheltered the albatross colony were gone, with almost the entire island covered in lava. The risk of extinction of the entire colony is lessened because of the existence of immature and nonbreeding birds that are away from the breeding colonies and at sea. However, another eruption also would destroy nesting habitat, could result in further loss of genetic variability and, thus, increase the long-term risk of extinction of this species.

Short-tailed albatross also are negatively impacted by adverse weather during nesting. Rain associated with monsoons and typhoons can cause mudslides and erosion and, in so doing, could kill individuals and destroy breeding habitat at Torishima (65 *FR* 46644). Erosion control on Torishima and attempts to establish a second breeding colony on the island are efforts being taken to improve long-term population viability.

V.C.5.f(4)(b)4) Purposeful Take

Japanese fishers hunting seabirds (H. Hasegawa, cited in 65 *FR* 46644) occasionally might take short-tailed albatross. No other direct take is known to occur. No take by Alaskan Natives is documented.

Diseases and Parasites. No diseases currently are known to affect this species, but chicks of other species of albatross on Midway Atoll have been affected by an avian pox (65 *FR* 46644). There is no current evidence of parasites on Torishima or evidence of population-level impacts from parasites reported in the past (H. Hasegawa, cited in 65 *FR* 46644). However, parasites have been historically documented on short-tailed albatross on Torishima: a feather louse, a bloodsucking tick, and a carnivorous beetle (Austin, 1949).

V.C.5.f(4)(b)5) Contaminants and Debris

Short-tailed albatross are vulnerable to risks from contaminants and marine debris, including contaminants from crude oil and its byproducts, organochlorine pesticides and their byproducts, and discarded plastic wastes. As summarized elsewhere, short-tailed albatross could be harmed by spilled oil through ingestion, inhalation, and especially, oiling of its plumage. There is risk from oil spills in many parts of the vast marine range of this species from vessel groundings or other accidents, spills due to pipeline ruptures or other petroleum development-related operations. Throughout the range in the Aleutian Islands, for example, there have been numerous oil spills of various magnitudes. The greatest risk to the population would result from an oil spill near the breeding colonies during the nesting season, due to the concentration of individuals that could be affected. However, individual of this species are typically observed alone or in very small groups (USDOI, Fish and Wildlife Service short-tailed albatross sighting database). Thus, it is highly unlikely that significant numbers of individuals would be oiled by a spill. For example, the *Exxon Valdez* oil spill resulted in the release of a very large amount of oil that spread over many hundreds of square miles, including areas where short-tailed albatross have been observed. However, we have no evidence of a significant impact of *Exxon Valdez* oil on the short-tailed albatross. Population growth rates in the following years were normal.

As with susceptibility to being caught incidental to fishery interactions, the susceptibility of albatross to the impacts of an oil spill varies, depending on the abundance and the use of the species in the area in which the spill occurs. Based on examination of historic spills and oil-spill modeling that indicate that oil spilled in Cook Inlet is most likely to travel through Shelikof Strait, it is unlikely that short-tailed albatross would encounter spilled oil. As noted previously, sightings in Shelikof Strait or Cook Inlet are very rare. Densities even in the Gulf of Alaska are low, groups of more than two are rarely encountered and, thus, the probability that a short-tailed albatross would encounter oil spilled in Cook Inlet is very low.

The impacts of plastic ingestion on the recovery of short-tailed albatross are unknown (USDOI, Fish and Wildlife Service, 1999), but there is no current evidence suggesting that such ingestion is significantly limiting population recovery. H. Hasegawa (cited in USDOI, Fish and Wildlife Service, 1999) reported that short-tailed albatross on Torishima commonly regurgitate large amounts of plastic debris, and the frequency of occurrence has increased over the last decade (R. Steiner, reporting observations of H. Hasegawa, cited in USDOI, Fish and Wildlife Service, 1999). The Laysan albatross and blackfooted albatross also are known to ingest plastics, presumably either mistaking them for food or consuming them in the process of eating prey attached to the plastic (for example, fish eggs) (USDOI, Fish and Wildlife Service, 1999). Laysan albatross chicks found dead in the breeding colony had greater plastic loads than chicks whose death was caused by vehicle strikes (Auman, 1994). Plastic ingestion can cause internal injury if sharp pieces are eaten, can harm the animals' health by reducing food intake and/or assimilation, and can cause dehydration (Sievert and Sileo, cited in McDermond and Morgan, 1993).

V.C.5.f(4)(b)6) Fisheries Interactions

The Fish and Wildlife Service (1999) concluded that longline fisheries in the Bering Sea and North Pacific Ocean pose a risk to the short-tailed albatross. Seabirds can be impacted negatively by groundfish fisheries through incidental take in gear. Seabirds, including albatross, are attracted to the bait on longline hooks, attempt to take the bait, become hooked and pulled underwater, and drown (USDOI, Fish and Wildlife Service, 1999; Rivera and Wohl, 1999). It was the documentation of extremely high levels of mortality of other species of albatross (44,000 per year or average catch rate of 0.41 birds per 1,000 hooks) in longline fisheries in southern oceans (Brothers, 1991) that spurred the implementation of seabird bycatch measures by the Commission for the Conservation of Antarctic Marine Living Resources in 1992 (Rivera and Wohl, 1999). The majority of take of short-tailed albatross in Alaskan groundfish fisheries occurs in longline gear. In Russian waters, short-tailed albatross are sometimes taken in an offshore driftnet fishery (Steiner, 1998). The Fish and Wildlife Service has concluded that fishing activities other than hook and line longline fishing in Alaska and Hawaii are not likely to take this species. There have not been reported takes of short-tailed albatross in pelagic longline fisheries in the vicinity of the Hawaiian Islands, but unreported take may occur (E. Flint, cited in USDOI, Fish and Wildlife Service, 1999). In 1996, both blackfooted (1,189) and Laysan (625) albatross were taken in the fishery (Food and Agriculture Organization of the United Nations, 1998; USDOI, Fish and Wildlife Service, 1999). The majority of longline fisheries remain unregulated and unmonitored (Flint, 2002, pers. commun.), and there is little information available about the impact of foreign fisheries on this species (USDOI, Fish and Wildlife Service, 1999).

Estimates of the numbers of seabirds taken incidental to fisheries in Alaska are based on observer reports of the number of birds taken in observed sets, total fish catch, vessel effort (i.e., the number of hooks) for observed and unobserved sets, and seabird distribution (Rivera and Wohl, 1999). In the 1980's, two short-tailed albatross were killed in fishing-related activities in Alaska, one in a fish net north of St. Matthew Island and one incidental to halibut fishing in the Gulf of Alaska. Since 1990, five short-tailed albatross have been taken in fisheries in Alaska (USDOI, Fish and Wildlife Service, 1999). Three short-tailed albatross were taken between 1993 and 1999. The Fish and Wildlife Service (1999) concluded that the best available information indicated that two birds per year were taken in the Gulf of Alaska and Bering Sea/Aleutian Island hook-and-line fisheries in that 6-year period. The Fish and Wildlife Service also concluded that take in the commercial halibut longline fishery in U.S. waters off Alaska within the International Pacific Halibut Commission regulatory zones 2B, 2C, 3A, 3B, 4A, 4B, 4C, 4D, and 4E is likely to adversely affect but not jeopardize short-tailed albatross. After using computerized simulations to evaluate the possible effects of incidental take in fisheries on the short-tailed albatross population on Torishima, Cochrane and Starfield (1999) concluded that documented levels of incidental take of short-tailed albatross (using the value of 0.5% take per year) were having a modest impact on population increase (for example, a 6% increase in recovery time). Between 1983 and 1998, 6 out of 7 short-tailed albatross reported taken incidental to fisheries in Alaska were less that 6 years old (National Marine Fisheries Service, 1998). The Fish and Wildlife Service has been providing seabird-deterrent devices to longline fishing vessels in Alaska to attempt to reduce take associated with these fisheries (USDOI, Fish and Wildlife Service, 2000b.

As noted previously, the Fish and Wildlife Service has concluded that, with regards to foraging areas within the U.S., "…there is no information to support a conclusion that any specific marine habitat area within United States jurisdiction are uniquely important…the proposed rule also concluded that there would be no additional benefit or protection conferred through the destruction or adverse modification standard…Furthermore, there were no areas that we could identify as meeting the definition of critical habitat" (65 *FR* 46644).

Cochrane and Starfield (1999) pointed out that the impact of incidental take could pose threats to the short-tailed albatross not currently identified, if severe population reduction occurred due to some catastrophic event at the major breeding colonies or if fecundity or survival rates were significantly negatively impacted b some other factor. The same is true for the analyses presented here. However, based on current population status and trends, the Proposed Action is not likely to have significant adverse impacts on the short-tailed albatross.

V.C.5.f(4)(c) Cumulative Effects on the Steller's Eider

Steller's eiders could be severely affected by a very large oil spill that contacted large numbers of individuals that winter in Cook Inlet, the Kodiak Archipelago, and the Alaska Peninsula. However, the probability of such a spill occurring and impacting significant numbers of the Alaska breeding population of Steller's eider is small. There is no evidence of adverse impacts on this species from existing State leases in Cook Inlet.

The Fish and Wildlife Service presently has no evidence that modification of the marine environment has caused decline in the Alaska breeding population of Steller's eiders (66 *FR* 8850). The National Marine Fisheries Service (2002b) reported that within the marine range of the Steller's eider, the marine environment has likely been affected by human activities including commercial fishing, marine transport, and environmental pollutants. They also reported that Steller's eiders possibly could be threatened by changes in prey availability associated with ecosystem change in the Bering Sea.

Factors impacting the recovery of the Alaska breeding population of Steller's eiders are not well understood. Quakenbush and Suyudam (1999) reported that small housing developments near Barrow pose a threat to some nesting habitat. Increased human settlement of areas near Barrow and elsewhere on the North Slope results in habitat loss, increased disturbance of Steller's eiders, and often increases in nest predator populations (National Marine Fisheries Service, 1993). Other risks to be evaluated by the Steller's eider Recovery Team include disturbance in molting and wintering areas, vulnerability to oil spills, and predation during the breeding season (Quakenbush and Suyudam, 1999). The Fish and Wildlife Service (2002c) reported that North Slope breeding habitat is largely uninhabited and unaltered by humans. They reported also that a small portion of the potential breeding ranges of this population has been altered by oil and gas development. They list construction, off-road vehicle use, accidental spills of toxic materials, wetland filling and indirect effects of human presence on previously uninhabited areas as impacts of such oil development. Steller's eiders are still harvested (USDOI, Fish and Wildlife Service, 2002c), but the percentage of the harvest that is taken from the American breeding population is not clear. Lead contamination of Steller's eiders has been documented near Barrow and on the Yukon-Kuskokwim Delta (Franson et al., 1995; Flint, Petersen, and Grand, 1997; Flint and Herzog, 1999; USDOI, Fish and Wildlife Service, 2002f).

V.C.5.f(4)(d) Cumulative Effects on the American Peregrine Falcon

Activities on State oil and gas leases are not expected to have discernible impacts on peregrine falcons. Onshore activities have the greatest probability of impact, but this species is rare in the area and unlikely to suffer from adverse impacts. Neither fishery activities nor oil spills outside of Alaska likely would impact this species. The successful recovery of this subspecies indicates that significant adverse impacts are not having substantial negative impacts on population viability. Their endangered status primarily was due to contaminants in the environment. If use of some of these same and related contaminants increases in developing countries and they are atmospherically transferred to the arctic and subarctic, it possible that this species could again be vulnerable to contaminant-related decline. Peregrines are top predators that are vulnerable to the effects of the bioaccumulation of environmental contaminants. As reviewed in Risebrough and Peakall (1988), research indicated the decline of peregrine falcons was due to contamination by organochlorine pesticides, especially DDT and its metabolites (such as DDE), which accumulated in the fatty tissues of species ingesting contaminated food (Fyfe et al., 1988). Exposure to organochlorines can affect peregrine falcons through reproduction and through direct mortality. The effect on mortality is not as well studied. However, organochlorines can adversely affect peregrine reproduction by causing the thinning of eggshells, premature breakage of eggs, addling of eggs, hatching failure, and abnormal reproductive behavior of the adults (Risebrough and Peakall, 1988). The DDE can prevent normal calcium deposition. Populations of peregrines with eggshells that were on average 17% (or more) thinner than normal had high enough rates of reproductive failure to cause population decline (Peakall and Kiff, 1988). Thus, the previous endangered status of the American peregrine falcon resulted from widespread eggshell thinning and reproductive failure caused by exposure to persistent organochlorine due to the bioaccumulation of chlorinated pesticides (Ambrose et al., 2000).

Successful reproduction in some areas virtually ceased (Hickey and Anderson, 1969). The degree of exposure varied among areas (see 64 *FR* 46542) with resultant differences in the degree of impact on the populations. In most areas of the Pacific coast of Alaska, breeding populations of peregrines remained fairly stable (64 *FR* 46543). In contrast, impacts in many other regions of North America were severe. In agricultural and forested areas east of the Mississippi River in the U.S. and in eastern Canada south of the boreal forest, in Great Plains states east of the Rocky Mountains and south of the boreal forest in the U.S. and Canada, peregrines were extirpated in the DDT era (Cade, 1975; Enderson et al., 1995; Berger, Sindelar, and Gamble, 1969). Peregrines also were significantly reduced west of the 100th meridian (Enderson, 1969), disappeared as a breeding species in southern California, and declined greatly in other parts of the western U.S. and in many parts of southern Canada and the Northwest Territories (Kiff, 1988).

V.C.5.g. Marine and Coastal Birds

In addition to development of the prospects associated with the Cook Inlet Sales 191 and 199, other Federal and State projects and associated activities that could contribute to cumulative effects on marine and coastal birds which occur seasonally or reside in the Cook Inlet region are outlined in Section V.B. Other projects and activities occurring in Cook Inlet, along migration routes, or in winter ranges could also contribute to cumulative effects. These include commercial fishing, commercial development, environmental contamination, marine shipping, and recreational activities.

V.C.5.g(1) Conclusion

A major source of seabird mortality in the North Pacific, including Alaskan waters, is incidental bycatch in commercial fisheries; however, marine and coastal birds nesting in the Cook Inlet region probably have not been seriously affected by such bycatches. Introduced predators are also a serious threat to burrow-nesting seabirds on many islands in Cook Inlet, as discussed below in Section V.C.5.g(3)(c). Other sources of cumulative effects on seabirds include offshore oil and gas activities, vessel and air traffic, and commercial timber harvests. The effects, including direct mortality, reduced reproductive success, and habitat loss, are relatively localized but long term. Recovery would be expected to require multiple generations and in some cases, such as with declining populations, might not occur at all.

The greatest risk to seabirds in the Cook Inlet region would be from an oil spill occurring during the summer (April-September), when hundreds of thousands of birds may be present in the lower Cook Inlet and northern Shelikof Strait. Although unlikely, a large spill occurring here during the summer months could kill thousands to tens of thousands of birds. The magnitude of mortality would depend on the size, exact timing, and movement of the spill. Recovery from this level of impact could require multiple generations, and species in population decline would not be expected to recover if this situation continued.

V.C.5.g(2) Incremental Contribution to Cumulative Effects from Cook Inlet OCS Sale

Noise and disturbance associated with exploration, development, and production resulting from proposed Sales 191 and 199 would be expected to contribute a minor increase in overall impacts on marine and coastal birds in the Cook Inlet region. These effects would primarily be due to helicopter support traffic and would be very localized.

These sales expected to contribute about 36% of potential offshore spills and roughly proportional effects on marine and coastal birds (0.21 of 0.58 estimated mean total spills shown in Table V-10).

V.C.5.g(3) Cumulative Effects from Other Projects and Activities

V.C.5.g(3)(a) Noise and Disturbance

Section IV.B.1.g discusses the potential sources of disturbance to marine and coastal birds in the Cook Inlet area from routine operations associated with offshore exploration, development, and production activities. Impacts on birds at sea from drilling rigs, seismic surveys, and support vessel traffic are expected to be limited to the immediate vicinity of the disturbance and very short in duration (i.e., a few minutes to hours). We expect that other commercial and recreational vessel traffic will have similar, minor impacts on marine and coastal birds in the area. Although difficult to quantify, another source of potential disturbance to seabirds is from tourism (for example, cruise ships, ecotourism, and birding tours) and other recreational activities (for example, boating, fishing, kayaking, and camping).

Routine helicopter traffic associated with the proposed sales is expected to originate from the Kenai/Nikiski area and to result in very minor impacts, limited to reduced productivity and nesting success for a few individuals for periods ranging from 1-2 years to the life of the project. However, this level of activity represents a very small percentage of total air traffic in the Cook Inlet region, which includes traffic associated with ongoing oil and gas production, tourism, sport fishing, and other recreational activities. In 2001, 78,900 flights were recorded at the Kenai airport and 35,100 at the Homer airfield. This overall level of air traffic would be expected to result in substantially greater impacts on locally nesting coastal and marine birds, including long-term (more than one generation) displacement from or abandonment of nesting areas within 1 mile of airfields.

V.C.5.g(3)(b) Commercial Fisheries

A major source of seabird mortality in the North Pacific is incidental bycatch in commercial fisheries. From the 1970's into the 1990's, most recorded mortality occurred in the high-seas driftnet fishery. At peak, an estimated 250,000-750,000 seabirds were being taken incidentally in the North Pacific, Bering Sea, and Gulf of Alaska each year (USDOI, MMS, 1996). Fortunately, a combination of international efforts, including a United Nations resolution, U.S. (Federal) legislation, and monitoring, substantially reduced the use of this gear on the high seas by the mid-1990's (CRS, 1995).

Currently, the major source of seabird mortality in the North Pacific appears to be the pelagic longline fishery (National Marine Fisheries Service, 2001c). Alaskan groundfish fisheries have been monitored periodically since 1990 in two regions: the Bering Sea/Aleutian Islands and the Gulf of Alaska. Based on observer data from 1993-1999, longline fisheries in these areas accounted for more than 88% of the recorded bycatch whereas trawling accounted for about 11%. The annual bycatch in the longline fisheries during this period was estimated at 17,000 birds. The majority of the birds identified were northern fulmars although gulls, albatrosses, and shearwaters were also taken in substantial numbers.

However, given the large geographic area and species involved, the numbers of seabirds nesting in the Cook Inlet region probably have not been seriously reduced by these pelagic fisheries (USDOI, MMS, 1996). Nearshore land-based gillnet fisheries may cause more serious effects on local populations (DeGange and Day, 1991) although specific seabird colonies in the Cook Inlet region appear not to have suffered high mortality directly attributable to commercial fishing (USDOI, MMS, 1996; Fadely, 2002).

V.C.5.g(3)(c) Introduced Animals

From the 19th to the early 20th Century, arctic and red foxes were introduced for commercial fox farming on almost every island from the Aleutians eastward to Prince William Sound, and on some of the southeastern Alaskan islands (Jones and Byrd, 1979). This resulted in the decimation of at least 6 of the 25 colonial seabird species populations on these islands (Lensink, 1984). Since the removal of foxes from many islands, these seabird populations have been recovering. However, introduced rats are present on many islands and are a serious threat to many burrow-nesting species (Bailey, 1993; Bailey and Kaiser, 1993).

The impact of introduced predator species on Alaskan seabird populations, particularly burrow-nesting species such as puffins, auklets, and murrelets, has been long term (multiple generations) and interregional, with hundreds of seabird colonies affected. This predation probably has resulted in the loss of hundreds of thousands of seabirds. Some seabird colonies in the Cook Inlet region have not recovered and still are being affected by predation from introduced rodents.

V.C.5.g(3)(d) Commercial Timber Harvests

Both marbled and ancient murrelets, which nest in old-growth forests in the Pacific Northwest, including the Cook Inlet region, have lost nesting habitat from clear-cutting of old-growth forests along the coast (Sealy and Carter, 1984; Vermeer et al., 1984). In the Cook Inlet region, timber harvests on Afognak Island totaled about 20,000 acres by the early 1990's, with a projected harvest of 3,000 acres per year for the next 30 years (Wiedmer, 1993, pers. commun.). There are also ongoing and planned timber harvests in the Tongass National Forest in Southeast Alaska adjacent to the proposed sale area.

These timber harvests on Afognak Island and the Kenai Peninsula have resulted in decreased nesting habitat for both marbled and ancient murrelets and have also led to the loss of bald eagle nesting habitat. Future timber harvests are expected to result in the continued loss of nesting habitat for these species. These effects would be long term since at least 100 years would be required for logged areas to return to old-growth habitat suitable for nesting murrelets (Sealy and Carter, 1984).

V.C.5.g(4) Cumulative Effects of Oil Spills and Large Gas Releases from OCS and State of Alaska Oil and Gas Activities

Activities in Cook Inlet that are most likely to result in a large spill are shipping and oil production, both of which occur in State waters in upper Cook Inlet. The estimated mean number of tanker spills due to past, present, and reasonably foreseeable oil activities in the Cook Inlet is 0.11; the most likely number of spills resulting from this source is zero (Table V-10). The estimated mean number of spills from exploration and production activities increases from 0.21 for Sales 191 and 199 to 0.58 for the cumulative case; the most likely number of spills is also zero for this source (Table V-10). Thus, no oil spills are assumed to occur in the Cook Inlet under the cumulative case. The potential effects of a 1,500- to 4,600-barrel spill on marine and coastal birds in the Cook Inlet area are discussed in Section IV.B.1.g. Impacts on marine and coastal birds from such a spill could involve the loss of hundreds to possibly more than ten thousand birds, depending on the timing and size of the spill. Depending on the number of birds lost and the species involved, recovery from these losses could require 1 year to two generations. The effects of a large gas release and ensuing explosion and fire on marine and coastal birds are described in Section IV.B.1.g(2).

Mortality associated with a natural gas release could involve a few to hundreds of individuals; these losses would be replaced within about 1 year.

V.C.5.g(5) Transportation Effects

Several oil spills have occurred in the Cook Inlet (see Section V.B), including the *Glacier Bay* oil spill in 1987, the Platform Anna spill in 1989, and the Kenai Pipeline East Forelands spill in 1992. The largest of these, a 3,100-barrel spill from the tanker *Glacier Bay*, reportedly killed only a few seabirds. No impacts on coastal and marine birds were documented for the other two spills.

The principal examples for estimating potential transportation spill effects on birds in areas such as Cook Inlet and the northern Gulf of Alaska are those resulting from the *Exxon Valdez* oil spill. About 10% of the oil from this spill exited Prince William Sound and passed the Kenai Peninsula, and only about 2% reached the Shelikof Strait (Galt, Lehr, and Payton, 1991). By the time oil reached the Barren Islands, approximately three weeks after the spill, it was in the form of widely scattered patches and lines of sheen; visible oil extended into southern Cook Inlet as far north as about Anchor Point (Morris and Loughlin, 1994).

Following the *Exxon Valdez* oil spill, more than 30,000 dead birds were collected, most of them outside Prince William Sound (Piatt et al., 1990). The actual toll probably was 3-10 times this number. Species that have recovered or are recovering include the bald eagle, black oystercatcher, marbled murrelet, and common murre (*Exxon Valdez* Oil Spill Trustee Council, 2001). Those not recovering or for which the degree of recovery is unknown include the common loon, cormorants, harlequin duck, pigeon guillemot, and Kittlitz's murrelet. The recovery period for these species to date has spanned as many as four generations; recovery from an event of this magnitude obviously requires a lengthy period and is complicated by other factors before and after the spill that increase mortality or decrease production of offspring, or both.

For purposes of the cumulative analysis, it is assumed that the transportation of Trans-Alaska Pipeline System oil out of Valdez to West Coast markets will result in seven spills of 4,000 barrels (five in port and two at sea) and two spills of 13,000 barrels at sea (Section V.C). It is further assumed that the in-port spills would be cleaned up relatively quickly. Vulnerable species during winter and spring/fall migration would include loons, waterfowl, shorebirds, and some auks; in summer, the main groups affected would be herons, rails, and various seabirds.

It is assumed that the offshore spills would occur 80-100 nautical miles from shore with a 5% to 10% chance of contacting the shoreline within 30 days. Given these low probabilities of shoreline contact, at-sea spills of this size would not be likely to have serious effects on Cook Inlet bird populations or to reach large areas of habitat critical to the survival of bird populations until weathering and dispersion rendered the oil much less harmful. It is expected that mortality would be relatively low and that recovery periods would be relatively short, except for species whose populations are declining and/or have a low reproductive rate. Recovery periods would lengthen in the unlikely event that more than one spill affected the same populations within the same interval.

In addition, it is assumed that a very large, 250,000-barrel tanker spill will occur in the Gulf of Alaska. There is an extremely small likelihood that such a spill would reach the Cook Inlet/Shelikof Strait area. However, a tanker spill in this area that did reach the shoreline could, depending on the season, cause substantial losses of migrating shorebirds and waterfowl or of overwintering loons, sea ducks, and gulls. The potential effects of a large spill between April and September within 50 miles of shore in the Gulf of Alaska are discussed in Section IX.B.3 of the Liberty final EIS (USDOI, MMS, Alaska OCS Region, 2002). The exposure of marine and coastal birds to such a spill would be expected to seasonally affect several species—including yellow-billed loons, pelagic cormorants, harlequin ducks, Aleutian terns, Kittlitz's murrelets, and bald eagles—most severely, resulting in the loss of thousands of marine birds and tens of eagles. Recovery from this level of impact would require multiple generations, and species in population decline would not be expected to recovery while this situation continued.

V.C.5.h. Nonendangered Marine Mammals

In this section, the cumulative effects of other past, ongoing, and planned projects, as well as the Proposed Action, on nonendangered marine mammals (Pacific harbor seals; northern fur seas; southcentral Alaska sea otters; harbor porpoises; Dall's porpoises; and killer, gray, and minke whales) are discussed. Although the chance of any or all of the planned future and ongoing offshore and onshore projects reaching developmental stages generally is unknown, this analysis assumes that all the projects discussed in this section reach developmental stages. These projects could affect nonendangered marine mammals through oil spills, noise and disturbance, habitat alteration, and other factors.

V.C.5.h(1) Conclusion

The overall potential cumulative effect on nonendangered marine mammals—particularly harbor seals—is estimated to include reduced distribution and abundance persisting for more than 1 year to several years, with the primary source being competition or conflict with commercial fishing for the same food sources in the marine environment. Other sources of effect, such as air and vessel traffic and local habitat alteration, are expected to cause short-term (less than 1 hour) disturbance of harbor seals, the Southcentral Alaska Stock of sea otters, and nonendangered cetaceans and/or cause local reduction in habitat or reduced habitat use by local assemblages of seals but are not likely to affect marine mammal populations. The contribution of the proposal is estimated to include 7% of the oil and gas activity long-term (life of the oil field) local effects on coastal habitats.

V.C.5.h(2) Effects of Oil Spills from OCS and State of Alaska Oil and Gas Activities

The mean number of offshore spills increases to 0.58 under the cumulative case from 0.21 under Alternative I, and the most likely number of spills is zero. The estimated number of tanker spills is 0.11 for past, present, and reasonably foreseeable oil activities; and the number is zero tanker spills for Cook Inlet Sales 191 and 199. Thus, no spills are assumed under the cumulative case. Potential effects of a 1,500- to 4,600-barrel spill are assessed in Section IV.B.1.

V.C.5.h(3) Effects of Noise and Disturbance

Noise and disturbance activities that may affect marine mammals in the sale area include geophysical surveys, marine dredging and construction, support vessels, aircraft overflights, offshore drilling and production, and other marine vessel traffic through the sale area. Marine mammal population vulnerability to disturbance depends on several factors, including the following:

1. number of animals involved,
2. sensitivity of the species,
3. presence of preferred habitat in relation to the disturbance, and
4. characteristics of the disturbance source.

The loudest noise source created by industry activity was identified as seismic noise and is expected to have minimal effects on nonendangered marine mammals. Overflight-disturbance reactions probably would be short-term, with seals reoccupying haulout sites and whales continuing their activities usually within a matter of less than 1 hour. For a complete discussion of the potential effects of noise and disturbance on marine mammals, see Section IV.B.1.h.

Considerable amounts of air and vessel traffic are associated with petroleum development and commercial vessel traffic in the Cook Inlet area. For example, an estimated one to two helicopter trips per day (per each production platforms) are assumed to be associated with offshore development under the proposal. Such levels of traffic probably would result in some unrestricted low-elevation flights over concentrations of harbor seals at haulout sites in the Cook Inlet area. This disturbance is expected to have short-term (a few minutes to less than less than 1 hour) effects on some aggregations of harbor seals.

An estimated 324 dockings by ships in excess of 400 tons occurred in Cook Inlet ports with the largest component being 125 cargo ships passing through the sale area on their way to and from Anchorage (see Section III D.4 - Marine Transportation). Air traffic to and from the Kenai airport included 78,900 operations in 2001 and the Homer airfield included 35,100 flights in 2001. The effects of cumulative aircraft and vessel traffic associated with tourism, sport fishing, and other recreation activities as well as potential oil development in the Cook Inlet area might reduce the use of habitats by seals near and along heavily traveled tour-vessel and air-traffic routes in Kachemak Bay. The recent increase in tour- and cruise-ship traffic in Kachemak Bay is a potential source of disturbance to pupping and “hauled-out” harbor seals that use the haulout area for giving birth to their young. This traffic could potentially disturb several hundred seals and could result in the loss or abandonment of seal pups and the displacement of seals from parts of the bay with frequent traffic.

V.C.5.h(4) Effects of Past Commercial Harvest

Before passage of the Marine Mammal Protection Act in 1972, the Pacific harbor seal was commercially harvested at rookeries in the western Gulf of Alaska (such as on Tugidak Island) and in the southern Bering Sea, with annual average harvest amounting to about 50% of pup production. If this level of seal-pup harvest was excessive, it might have resulted in a delayed decline (estimated decline of about 27% between 1964 and 1972) characterized by poor production as the low-numbered age classes reached productive maturity; however, because the commercial harvest ended more than 20 years ago, considerable recovery of harbor seal populations would have been expected after 1972 (Pitcher, 1986; Pitcher, 1990). Thus, commercial harvest in the 1960’s probably was not a primary factor in the recent decline of harbor seals in the Gulf of Alaska. The Tugidak Island population declined by about 85% between 1976 and 1988 (Pitcher, 1990), and the Prince William Sound population declined 40% between 1984 and 1988, based on trend-count surveys (Frost et al., 1991). The causes of these declines are not apparent.

V.C.5.h(5) Effects of Commercial Fishing in the North Pacific Ocean

Marine mammals are accidentally injured or killed because of certain commercial-fishing operations and, in some cases, intentionally harassed, injured, or killed. The National Marine Fisheries Service is responsible for managing these fishery interactions as mandated by the Marine Mammal Protection Act, as amended. Several marine mammal species may be subject to take by commercial fisheries and thus warrant consideration under the cumulative case. Estimated annual removal for these species for all of the Alaska Exclusive Economic Zone are fewer than 15 fur seals, fewer than 300 harbor seals, fewer than 10 beluga whales, fewer than 1 killer whale, fewer than 100 harbor porpoises, fewer than 10 Dall’s porpoises, and fewer than 10 minke whales (National Marine Fisheries Service, 1992). For the purpose of the cumulative-case analysis, one-third of these numbers are assumed to be the lethal take for these species in fishery interactions each year in the sale area.

Harbor seal and harbor and Dall’s porpoise mortalities due to marine oil spills are additive to the losses of these marine mammals that occur from the driftnet fishery in the North Pacific, Bering Sea, and Gulf of Alaska and that are incidentally killed each year. Such losses occur over a large geographic area in the northern Gulf of Alaska and probably do not seriously reduce the number of seals and porpoises in the Cook Inlet area. However, an increase in the intensity of the fishing effort could increase the take of harbor seals and porpoises.

The growing exploitation of bottomfish, such as the pollock fishery in the Bering Sea and Gulf of Alaska including Shelikof Strait, theoretically could reduce the availability of prey to some harbor seal populations if pollock stocks collapsed (significant and substantial reduction of juvenile young age-class pollock) from future overharvest. The present level of pollock harvest in the Bering Sea and Gulf of Alaska apparently has contributed to the recent drastic decline of northern sea lion populations in the southern Bering Sea and the Gulf of Alaska. However, the decline in harbor seal numbers in the gulf started before the extensive harvest of pollock in the gulf commenced, suggesting that there is no connection between this fishery and the decline in harbor seals (Pitcher, 1990). The reason for the decline is unknown, but it mirrors the decline of Steller sea lions in the gulf. The harbor seal decline in Cook Inlet-Western Gulf of Alaska may be related to the crash of the pandalid shrimp and capelin populations in the same area and over the same time period (Hansen 1997; Anderson and Piatt, 1999). Predation by killer whales or sharks, or both, also could be a contributing factor. Shark predation on harbor seals has been recorded (Lucas and Stobo, 2000; Stewart and Yochem, 1985).

The possible development of other fisheries in Alaska, such as for capelin (as on the Atlantic coast), would result in direct competition between harbor seals, cetaceans, and commercial fishing for the same-size fish and could result in significant seal and perhaps cetacean mortalities incidental to this potential fishery.

V.C.5.h(6) Effects of Habitat Loss or Alteration on Nonendangered Marine Mammals

Habitat loss or alteration would be limited to temporary disturbance to some harbor seals and porpoises in the nearshore environment associated with construction of pipeline and transport facilities. Disturbance from habitat alteration/construction activities would be relatively short-term and very localized and should not affect marine mammal survival. For a complete discussion of the potential effects of habitat loss and or alteration on marine mammals, see Section IV.B.1.h.

IV.C.5.h(7) Effects of Logging on Nonendangered Marine Mammals

Within the Gulf of Alaska region, timber harvests occur on the Southeast Alaska islands such as Prince of Wales and Admiralty, in the Cape Yakataga area near the sale area, in Prince William Sound on Montague Island, on the Kenai Peninsula, and on Afognak and adjacent islands. Timber harvest can affect local populations of marine mammals (particularly sea otters) by reductions in local invertebrate prey populations due to benthic bark accumulations at log-transfer facilities. The log transfer facilities can reduce invertebrate populations dramatically within the local area of the facility but usually only a few hectares. This can affect individual harbor seals and porpoises by reducing their local foraging areas but unlikely would affect seal and porpoise populations.

V.C.5.h(8) Effects of Subsistence Hunting on Nonendangered Marine Mammals

Certain marine mammals are harvested by Native Alaskans for subsistence use. Fur seals, harbor seals, beluga whales, and sea otters all are subject to some level of lethal take by Native Alaskans. For example, about 2,000 harbor seals are harvested per year in the entire gulf (southern side of Alaska Peninsula to Southeast Alaska), as reported by Wolfe (1993). However, this rate of subsistence harvest on harbor seals probably is not large enough to cause the current population decline of harbor seals (Pitcher, 1990; Sease, 1992). Details on the subsistence take can be found in Section IV.B.1.l - Effects of Sale 191 on Subsistence-Harvest Patterns.

V.C.5.h(9) Transportation Effects on Harbor Seals, Southcentral Alaska Sea Otter Stock and other Nonendangered Marine Mammals

Although Cook Inlet Sale 191 is not expected to contribute any tanker spills to the cumulative analysis (mean number of spills is zero), potential future oil-spill effects from tanker transportation of arctic oil from the Trans-Alaska Pipeline System terminal at Valdez could have cumulative effects on marine mammals, especially the southcentral Alaska sea otter stock and harbor seals, in Prince William Sound and the Gulf of Alaska. There were local effects on harbor seals and sea otters that resulted from the 1989 *Exxon Valdez* oil spill. The Prince William Sound population has not recovered from its current decline due to environmental factors other than the spill.

Future transportation of North Slope oil through Prince William Sound could have a long-term (5 years or longer) effect on sea otters and harbor seals. The number of cumulative tanker spills is estimated to be six with an average size of 3,000 barrels; for purposes of analysis, one spill is assumed to be 200,000 barrels while the other five are assumed to be less than 15,000 barrels, of which two spills would average 13,000 barrels in size. These spills are expected to have similar effects on harbor seals as described but cause fewer losses of seals. Recovery of populations is expected within 5 years after the spills, assuming the same populations and habitats are not affected. If two or more of these spills affect the same populations and habitats within 1 or 2 years of the previous spill, recovery would take longer (perhaps 10 years or more).

If tanker spills associated with oil development in arctic Alaska, including Liberty, occurred south of the Gulf of Alaska, other nonendangered marine mammals and their habitats could be affected along the transportation routes or at marine ports. The effects of tanker spills on these marine mammals and their habitats are expected to be about the same as described above and in Section IV.F for seals and nonendangered cetaceans in the Gulf of Alaska.

V.C.5.h(10) Summary of the Cumulative Effects on Nonendangered Marine Mammals

The cumulative effect of human activities on nonendangered marine mammals included past commercial harvests of harbor seals in which the former species was drastically reduced. At present, the harbor seal population in Alaska has declined in the northern and western parts of the gulf. The cause or causes of this decline are not apparent. The greatest potential sources of cumulative effects on the Southcentral Alaska Sea Otter Stock and on harbor seals, and other nonendangered marine mammals identified in the above discussion, are commercial-fishery interactions with marine mammals and potential competition between fisheries and marine mammals for the same food resources of the marine environment, such as the pollock, herring, and salmon fisheries with harbor seals. This competition/conflict might result in further reduced seal and other nonendangered marine mammal populations in areas of high commercial exploitation of fish resources that is expected to persist for several generations.

Noise and disturbance from tourism, recreational and industrial air and vessel traffic, habitat alteration (oil exploration and development platform installation, and timber harvest log transfer facilities are expected to have short-term (less than 1 hour) displacement effects and/or local reduction in habitats or habitat use. These latter cumulative-effect sources may adversely affect nonendangered marine mammals, such as harbor seals inhabiting coastal areas very near heavily used air- and vessel-traffic routes, or seal and porpoises inhabiting areas near log-transfer facilities; but overall populations of harbor seals, and other nonendangered marine mammals likely would not be affected by the latter sources of development.

The contribution of the proposal to the overall cumulative effect on nonendangered marine mammals likely would include an estimated 7% of the oil and gas activity effects on coastal habitats. Some of this habitat effects is estimated to persist for more than 1 year (more than 5 years).

V.C.5.i. Terrestrial Mammals

The cumulative effects of ongoing and future development, as well as the Proposed Action, on brown bears, river otters, Sitka black-tailed deer, and other terrestrial mammals are discussed in this section. The following development activities do have actual or could have potential habitat-alteration, environmental-degradation, and direct mortality effects on brown bears, river otters, Sitka black-tailed deer, and other terrestrial mammals that reside in the Cook Inlet/Shelikof Strait region.

V.C.5.i(1) Conclusion

The overall cumulative effect on terrestrial mammals is expected to be reduced distribution and/or reduced abundance of brown bears and, to a lesser extent, reduced numbers of river otters and Sitka black-tailed deer from habitat degradation due commercial logging and other onshore development. Total recovery likely would take several generations. The contribution of Sale 191 to the cumulative case is estimated 7% of the oil and gas activity long-term (life of the oil field) local disturbance effects on terrestrial mammal habitat. No effect on regional populations likely would occur.

V.C.5.i(2) Effects of Oil Spills from OCS and State of Alaska Oil and Gas Activities

The mean number of offshore spills increases to 0.58 under the cumulative case from 0.21 under Alternative I - Proposed Action, and the most likely number of spills is zero. The estimated number of tanker spills is 0.11 for past, present, and reasonably foreseeable oil activities (Table V-10) and is zero tanker spills for Cook Inlet Sale 191. Thus, no spills are assumed under the cumulative case. Potential effects of a 1,500- to 4,600-barrel oil spill on terrestrial mammals are assessed in Section IV.B.1.i.

V.C.5.i(3) Cumulative Effects of Sport Hunting and Nonsport Mortality (Recreation Activities) on Brown Bears

Brown bear mortalities from human-bear encounters associated with hunting, fishing, and other recreation would be additive to the losses of bears that occurred from any oil spills associated with the proposed lease sales. An increase in the intensity of salmon sport fishing and hunting on the Kodiak Wildlife Refuge and adjacent areas, with more people encountering brown bears, is expected to increase the incidental, legal, and illegal sport taking of brown bears in the Kodiak-Afognak Island and the Alaska and Kenai Peninsula areas. Liberalized hunting regulations resulting in an increased sport harvest of brown bears could result in a decline in abundance-density of bears without necessarily resulting in an increase in survival of cubs to compensate for such losses (Miller, 1990). Bears that become familiar with people and begin to associate humans with food usually get involved in bear-human encounters, often with subsequent loss of these animals to the population (Warner, 1987).

The increase in human presence and encounters with brown bears associated with timber harvests, sport fishing, and hunting is temporary in nature; however, a long-term increase in human activity and/or the establishment of permanent settlements (for example, project areas and mines) and construction of access roads into bear habitat usually lead to human-bear conflicts and encounters on a regular basis at such places as dumps, in which bears learn to associate humans with food (Schallenberger, 1980; McLellan 1990). Initially, brown bears will avoid human settlements due to the noise and disturbance (Harding and Nagy, 1980; Kasworm and Manley, 1990), but if the area includes an important habitat, such as a salmon stream, the bears are likely to habituate to the noise and, consequently, to human presence. This leads to encounters with humans, who often will not accept the risk of bear attacks; and these encounters too often lead to the loss of bears (Archibald, Ellis, and Hamilton, 1987; McLellan 1990).

Nonsport (human-caused) mortality of brown bears in Alaska increased from 1970-1985 and is expected to increase further with development (for example, logging and mining) and establishment of settlements in remote areas (Miller and Chihuly, 1987). The losses of brown as well as black bears from incidental shootings by people in defense of life and/or property generally have not been significant to bear populations in Alaska as a whole, but such losses contribute to a cumulative decline in bears and in their distribution near cities and villages in Alaska. During the summer sport-fishing season, an estimated 60% of the Anchorage population and thousands of out-of-state tourists visit the Kenai Peninsula and seasonally populate the road system, streams, and parks of the peninsula (See Section III.C.5 - Recreation and Tourism). This growing influx of people is a cumulative disturbance factor for some brown bears and other terrestrial mammals that frequent habitats adjacent to the roads and waterways of the region.

As human populations in Alaska increase, the numbers of brown bears are expected to decrease, particularly outside of National parks, refuges, and wilderness areas.

V.C.5.i(4) Cumulative Noise and Disturbance Effects

Air traffic to and from the Kenai airport included 78,900 operations in 2001 while the Homer airfield included 35,100 flights in 2001. Surface transport along the Sterling Highway on the Kenai Peninsula included monthly average daily traffic levels of 12,000 vehicle passages in summer to 5,700 vehicle passages in winter for the Kenai segment (See Section III.D.3 - Surface Transport. An estimated 324 dockings by ships in excess of 400 tons occurred in Cook Inlet ports with the largest component being 125 cargo ships passing through the sale area on their way to and from Anchorage (See Section III D.4 - Marine Transportation).

Noise and disturbance associated with commercial and recreational activities (for example, air, boat, and road traffic and human presence) as well as traffic and increase in humans associated with oil and gas, commercial timber harvests, and other development in terrestrial mammal habitats generally have short-term (a few minutes to more than 1 hour) displacement effects on mammals within less than 1 mile of the traffic and other human activity. However, long-term displacement or reduced habitat use would occur for some individual terrestrial mammals within about 1 mile of airports, marine harbors, towns, highways, and other development facilities. This disturbance could result in an overall reduction in brown bear distribution on the Kenai Peninsula.

V.C.5.i(5) Cumulative Effects of Commercial Timber Harvests on Sitka Black-Tailed Deer

The total recent timber harvest on Afognak Island was about 20,000 acres, and the projected harvest is 3,000 acres per year for the next 30 years (Wiedmer, 1993, pers. commun.). Two logging camps and a log-transfer facility are located in Kazakof Bay on Afognak Island in an important wintering area for Sitka black-tailed deer (Map 16). Ongoing and planned timber harvests in the Tongass National Forest in Southeast Alaska and planned timber harvest on Afognak Island adjacent to the proposed lease-sale area have and will result in the removal of the old-growth-tree canopy from coastal winter-range habitat of the Sitka black-tailed deer. Old-growth western hemlock-Sitka spruce forests in southeast Alaska are more heavily used by Sitka black-tailed deer than nearby second-growth-forest stands (Wallmo and Schoen, 1980). During severe winters with heavy snow-cover accumulation, the deer use the understory vegetation of old-growth forests as important or critical forage (Hanley and McKendrick, 1985; Yeo and Peek, 1992). Large, dominant trees characteristic of old forests are better able to intercept snowfall than younger, even aged, second-growth trees and provide forage access for the deer, even during years of heavy snowfall (Kirchhoff and Schoen, 1985). The burial of shrubs by snow affects the availability of winter forage to Sitka black-tailed deer, even when prewinter shrub heights exceed the mean snow depth (Hovey and Harestad, 1992).

The depletion of high-volume, old-growth-forest stands by commercial logging is expected to adversely affect deer on winter range subject to periodic, deep snowfall (Kirchhoff and Schoen, 1985). The loss of old-growth-timber canopy on Afognak Island from proposed timber harvests is likely to have less of an effect on the availability of winter forage for deer on Afognak Island than timber harvests in Southeast Alaska because of the shallower snow depth in the Kodiak-Afognak Islands area (a mean depth of 21 inches in the city of Kodiak and 9 inches in Larsen Bay) in comparison to Southeast Alaska (60 inches or more) (Brower et al., 1988). However, the removal of large areas (20,000 acres and 3,000 acres per year) of forest canopy from Afognak Island is expected to reduce the availability of winter forage of Sitka black-tailed deer during winters of heavy snowfall and contribute to the population declines that occur during these years. This effect is expected to persist for several years.

V.C.5.i(6) Cumulative Effects of Commercial Timber Harvest and Other Coastal Development on Brown Bears

The total recent timber harvest on Afognak Island was about 20,000 acres, and the projected harvest is 3,000 acres per year for the next 30 years (Wiedmer, 1993, pers. commun.). Two logging camps and a log-transfer facility are located in Kazakof Bay on Afognak Island in an important spring habitat for brown bears (see Map 16).

Old-growth forest-riparian habitat in Southeast as well as Southcentral Alaska adjacent to the proposed sale area is important habitat for brown bears (Schoen and Beier, 1990). Old-growth-timber harvests that degrade salmon streams would adversely affect brown bears; and the construction of access roads into the forests is expected to increase human access to brown bears and increase both sport harvest of the bears and incidental mortality of bears in the project areas (Schoen and Beier, 1990; Titus and Beier, 1992). Logging roads that have been constructed and others that will be constructed for timber harvest on Afognak Island generally are open to the public when logging operations are not occurring and when operations are complete. This increased access by the public is expected to increase human-bear encounters and increase the mortality of brown bears on Afognak Island, leading to a possible population decline (perhaps 10%). This effect is expected to last for more than one generation.

The increase in public access (construction of roads and powerlines) and the incentive to develop rural lands near the Terror Lake Hydroelectric Project is expected to have a long-term local effect on Kodiak brown bears through increased disturbance and losses of bears to recreationists and settlers (Smith and Van Dalle, 1990).

V.C.5.i(7) Summary

Habitat alteration associated with timber harvest and other onshore development is expected to have long-term (more than one to several generations) effects on the availability of winter forage of Sitka black-tailed deer on Afognak Island and is expected to increase human access to brown bear habitats, leading to an increase in bear mortality (perhaps by 10%) and an overall reduction in brown bear distribution on the Kenai Peninsula and Afognak Island. Noise and disturbance associated with cumulative air, boat, and road traffic is expected to have short-term (a few minutes to less than 1 hour) displacement effects and local (within 1 mile) long-term (more than one to several generations) displacement effects on terrestrial mammals, especially brown bears near development facilities (this effect is directly related to human-bear encounters). Total recovery of river otters, brown bears, and Sitka black-tailed deer likely would take more than one to several generations for losses of habitat or habitat degradation.

Cumulative onshore development is expected to have a long-term (more than one generation) effect on the distribution and abundance of brown bears. The overall contribution of exploration and development activities associated with the proposal is not expected to affect regional populations of terrestrial mammals.

V.C.5.j. Economy

V.C.5.j(1) Conclusion

The reasonably foreseeable future projects identified in our cumulative analysis would generate increases in property taxes for the Kenai Peninsula Borough of 17%. These projects would generate revenue increases to the State of Alaska of less than 1.0% above the level without reasonably foreseeable future projects. We estimate a 1.5% increase of the 1999 work force of the Kenai Peninsula Borough and a corresponding percent increase for personal income for less than 5 years during development. We estimate that approximately 160 workers would be needed to clean up a 4,000-barrel spill; 520 workers for a 13,000-barrel spill, and 10,000 workers for a 250,000-barrel spill. For any given spill, they would work for 6 months in the first year the number would decline to zero by the third year following the spill. The above effects are additive. We anticipate no countervailing or synergistic effects.

V.C.5.j(2) Incremental Contribution to Cumulative Effects from Cook Inlet OCS Sale 191

The Cook Inlet Sale 191 would generate increases in property taxes for the Kenai Peninsula Borough that would average about 6% above the level of Borough revenues without Alternative I. Alternative I would generate revenue increases to the State of Alaska of less than 0.01% above the level without Alternative I. Total employment and personal income would not increase over the 2000 baseline for the Kenai Peninsula Borough and the rest of Alaska for each of the three major phases of OCS activity: exploration, development, and production.

For oil spills, we calculate the incremental contribution of the Cook Inlet Lease Sale 191 at 7.0%. See Section V.C.1 - Oil Spills and the Incremental Contribution of the Proposed Action in the Cumulative Analysis and Table V-9.

V.C.5.j(3) Cumulative Effects from Other Projects (Past, Present, and Future)

The economic effects of past and present projects are reflected in the description of the environment in Section III.C.1 - Economy. Section V.B.3 describes reasonably foreseeable future development and production within the next 15-20 years. Table V-13 describes major projects analyzed below. The analysis below indicates the increment over the 1999 baseline described in Section III.C.1. These are the effects of routine activity.

We estimate the total increase in property tax revenues due to major projects to be $8 million per year for the Kenai Peninsula Borough. The year 2000 property tax for the Borough is $46.5 million. An increase of $8 million represents an increase of 17.2% over the $46.5 million. The components for this are as follows:

- We estimate that the Statewide Areas Lease Sales 2003-2006 and Tyonek Deep will generate revenues half that of OCS Cook Inlet Lease 191, or $1.3 million (see Section IV.B.1.j).
- We estimate that the 33 miles of 6-inch pipeline from the Starichkof Oil Field near Ninilchik to Nikiski will generate property tax of $1.1 million on $90 million of value for the pipeline. We use pipeline cost data in Han-Padron Associates, 1985 and Consumer Price Index annual changes (U.S. Department of Labor, Bureau of Labor Statistics as quoted in Fried and Windisch-Cole, 2001) to estimate pipeline cost and value.
- We estimate the natural gas pipeline from Homer to Nikiski will generate $0.6 million of property on $50 million of value. The 33-mile-long, 12-inch diameter pipeline from Ninilchik to Nikiski to be constructed in 2003 is to cost $25 million (*Petroleum News Alaska*, 2001). The natural gas pipeline from the 33 miles from Ninilchik to Homer to be constructed at some time in the future is estimated to cost the same as the northern extension for a total of $50 million.
- The estimated cost for the Southern Intertie Project, an electrical power line project, Tesoro route, is $100 million (U.S. Department of Agriculture, 2001). We estimate the cost of the portion of the power lines in the Kenai Peninsula Borough to be $90 million. A portion of the power lines extend across Turnagain Arm of Cook Inlet to Anchorage. This would generate $1.1 million through property taxes. The Tesoro route for the Intertie is primarily on non-Federal property that can be taxed. The applicant's route onshore for the Southern Intertie Project would primarily cross

the Kenai National Wildlife Refuge, which is Federal land that is not taxable. Therefore, we have assumed the route with the maximum effect as analyzed previously.

- The cost of the British Petroleum gas-to-liquids test facility is $86 million (see Table V-13) which would generate $1.0 property tax.
- Sale 191 would generate $2.7 million of property tax on the value of a $222 million for the 12-inch diameter, 75-mile onshore oil pipeline and a $3 million 5-mile onshore gas pipeline (see Section IV B.1.j).
- We apply an average mill rate of 12 for the Kenai Peninsula Borough. These projects would be completed and taxable at different times over the next 15-20 years.

The cumulative case would generate revenue increases to the State of Alaska of less than 1.0% above the level without reasonably foreseeable future projects. A total of approximately $40 million annual in increased revenue is 1% of the $4 billion State of Alaska Budget in the 1998-2001 period (see Section III.C.1). The $40 million in annual revenue consists of the following components related to the major reasonably foreseeable projects.

- We estimate the State Area-wide Lease Sales 2003-2006 and Tyonek Deep will generate annual revenues of half of Sale 191, or $1 million.
- We estimate Starichkof will generate $4.5 million based on the ratio of 140 million barrels from Sale 191 to 300 million barrels from Starichkof.
- The natural gas pipeline from Ninilchik to Nikiski is designed for 120 million cubic feet of throughput per day (*Petroleum News Alaska*, 2001). We estimate $3 per thousand cubic feet revenue. The State royalty rate is one-eighth. This translates to $16 million annual revenue to the State. We assume the extension of the pipeline to Homer will deliver the same throughput and accrue another $16 million revenue to the State for a total of $32 million.
- The Southern Intertie Project and the British Petroleum gas-to-liquids plant will not generate revenue to the State.
- Sale 191 will generate $2 million (see Section IV.B.1.j).

Direct jobs and associated personal income generated by oil and gas projects that are reasonably foreseeable in the future would not increase over the 1999 base for the Kenai Peninsula Borough. The total of direct jobs would generate 192 indirect and induced jobs. These 192 jobs plus 45 direct jobs for the single non-oil and gas project would generate 237 jobs or 1.5% of the 1999 work force of the Kenai Peninsula Borough and a corresponding percent for personal income for less than 5 years during development. We estimate as many as 398 direct jobs during the peak of development, assuming that all of the reasonably foreseeable future projects occurred at the same timed. About 75% of these are in oil and gas developments. We assume no in-migration to the Kenai Peninsula Borough of direct OCS workers associated with Sale 191. See Section IV.B.1.j for explanation of this and further details and definitions of types of workers. For the same reasons we assume no in-migration for direct oil and gas workers for the State Area-wide Lease Sales 2003-2006, Tyonek development and production, Starichkof production, the natural gas pipeline, and the gas-to-liquids plant for the same reasons. We estimate a total of 192 indirect and induced jobs during the peak of development for less than 5 years generated by the direct employment and 45 direct jobs during in the Southern Intertie Project, the only non-oil and gas future project in this cumulative case. The sum of these (192 plus 45) is only 1.5% of the 1999 work force of 16,344 of the Kenai Peninsula Borough (see Section III.C.1 and Table III.C-1). See Table V-16 for employment and personal income estimates for the seven major projects for the reasonably foreseeable future. This table corresponds to the description of these projects in Table V-13.

V.C.5.j(4) Cumulative Effects of Oil Spills and Large Gas Releases from OCS and State of Alaska Oil and Gas Activities (Past, Present, and Future Facility and Pipeline Spills, Large Gas Releases)

In the event of an unlikely large oil spill for OCS Cook Inlet Sale 191, we estimate employment to clean up a possible large oil spill of 1,500 barrels to be 60 cleanup workers for 6 months in the first year. This would decline to zero by the third year following the spill. For a possible large spill of 4,600 barrels, we estimate employment to be 190 cleanup workers for 6 months in the first year, declining to zero by the third year following the spill. For further details of this analysis see Section IV.B.1.j(3)(c). No additional future spills greater than 1000 barrels are expected from developments in Cook Inlet. See Section V.C.1 - Differences in Cumulative Effects from Sale 191 Activities Compared to Sale 199. We calculate the incremental contribution of the Cook Inlet Sale 191 at 7.0%. See Section V.C.1 - Oil Spills and the Incremental Contribution of the Proposed Action in the Cumulative Analysis and Table V-9.

In the past, three spills occurred from pipelines in Cook Inlet between 1966 and 1968. Two were 1,400 barrels and one was 1,000 barrels. See Appendix A, Section A.1.c. We estimate employment to clean up an oil spill of 1,000 barrels to be 40 cleanup workers for 6 months in the first year. This would decline to zero by the third year following the spill. We estimate employment to clean up an oil spill of 1,400 barrels to be 56 cleanup workers for 6 months in the first year. This would decline to zero by the third year following the spill. We estimate the sum of workers to clean up these three past spills at 342. For further details of this analysis see Section IV.B.1.j(3)(c).

We anticipate no effects from the release of 5 to10 million cubic feet of natural gas during exploration or 10 million cubic feet during development from Cook Inlet Sale 191 or similar releases from other oil and gas exploration and development.

V.C.5.j(5) Transportation Effects

Seven spills occurred from tankers in Cook Inlet between 1966 and 1989. These ranged in size from 1,000 to 9,420 barrels. See Appendix A-1, Section A.1.d. We estimate employment to clean up an oil spill of 1,000 barrels to be 40 cleanup workers for 6 months in the first year. This would decline to zero by the third year following the spill. We estimate employment to clean up an oil spill of 9,420 barrels to be 377 cleanup workers for 6 months in the first year. This would decline to zero by the third year following the spill. We estimate the sum of workers to clean up these spills to be 925. They would work for 6 months in the first year and the number of workers would decline to zero by the third year following the spill.

In the future, the most likely number of oil spills greater than or equal to 1,000 barrels from Trans-Alaska Pipeline System tankers is nine. We estimate six spills with an average size of 4,000 barrels, four of which occur in port and two at sea. We assume two spills at sea each with an average size of 13,000 barrels. Finally, we assume one large, highly unlikely spill in the Gulf of Alaska of 250,000 barrels that could extend into Cook Inlet. In-port spills, where contingency measures are in place, would be cleaned up relatively quickly. Spills originating 80-100 nautical miles offshore would have a 5%-10% chance of contacting the shoreline within 30 days (LaBelle and Marshall, 1995). Recent new shipping lanes and port routes have been initiated by the National Oceanic and Atmospheric Administration, which require tankers to travel at least 50 nautical miles offshore central California to better protect three marine sanctuaries of Monterey Bay, the Gulf of the Farallones, and the Channel Islands. See Section V.C.1 - Transportation Assumptions.

We estimate the number of workers required for these past and future spills as follows. We estimate employment to clean up an oil spill of 4,000 barrels to be 160 cleanup workers for 6 months in the first year. This would decline to zero by the third year following the spill. For a spill of 13,000 barrels, we estimate employment to be 520 cleanup workers for 6 months in the first year, declining to zero by the third year following the spill. We estimate the sum of workers to clean up these spills to be 2,000. They would work for 6 months in the first year and the number of workers would decline to zero by the third year following the spill.

In the unlikely event of a 250,000-barrel oil spill in the Gulf of Alaska, activities associated with cleaning it up likely would employ about the same number of workers as associated with the *Exxon Valdez* oil spill. Approximately 10,000 cleanup workers worked for 6 months in the first year, declining to zero by the fourth year following the spill, along with price inflation above 25% during the first 6 months of the cleanup operation. These workers are additive workers. See Section IX.B.3.k of the Liberty Final EIS for details (USDOI, MMS, Alaska OCS Region, 2002). The same economic effects could occur whether the spill was in the Gulf of Alaska or farther south along the Canadian or U.S. west coast bordering on the Pacific Ocean.

For further details regarding the above analysis of workers needed to clean up oil spills, see Section IV.B.1.j(3)(c).

V.C.5.j(6) Components of the Kenai Peninsula Borough Economy

Native residents of the Kenai Peninsula Borough traditionally have relied on subsistence activities. Although not fully part of the cash economy, subsistence hunting is important to the economy for those practicing subsistence and even more important to culture. For effects on these aspects, see Sections V.C.5.l - Subsistence-Harvest Patterns and V.C.5.m - Sociocultural Systems. Other components of the Borough's economy are commercial fisheries, recreation and tourism, sports fisheries, and activities in national and state parks described in Sections V.C.5.k, V.C.5.n, V.C.5.o, and V.C.5.r, respectively.

V.C.5.k. Commercial Fisheries

This section considers the cumulative effects of other past, ongoing, and planned projects in Cook Inlet, as well as the Proposed Action. Commercial fishing could be affected by drilling discharges, offshore construction activities, seismic surveys, oil spills, and sport fishing. This analysis considers the potential cumulative effects of these events and activities on the commercial fishing industry in Cook Inlet.

V.C.5.k(1) Conclusion

Drilling discharges, offshore construction, and seismic surveys that have occurred to date have not had a measurable effect on the commercial-fishing industry of Cook Inlet; neither are the ones planned (including proposed Sale 191) likely to have a measurable effect. While sport fishing reduces the number of fish in Cook Inlet, this reduction is not likely to have a measurable cumulative effect on the commercial-fishing industry; neither is it likely to, unless current allocations between the sport- and commercial-fishing industries change substantially. An unlikely oil spill of 4,600 barrels or greater that occurred in the spring could cause State officials to close the fishery for a whole year because of tainting concerns. This action could result in a 100% loss for that year, not including losses due to damaged to boats and gear. A loss of this magnitude likely would have a significant effect on the Cook Inlet and Kodiak commercial-fishing industry.

V.C.5.k(2) Drilling Discharges, Offshore Construction Activities, and Seismic Surveys

Although infrequent, drilling discharges, offshore construction, and seismic surveys have been ongoing for many years in the Cook Inlet Region with no measurable effect on the commercial-fishing industry. Drilling discharges from all sources in the cumulative case are not expected to affect commercial fishing, due to the limited area affected near the platform-discharge point. Offshore construction, platforms, and pipelines, are expected to result in space-use conflicts in the cumulative case (for example, competition for docking space or gear loss); however, they are expected to be relatively few in number and minor in scope. Seismic surveys, planned and coordinated with the commercial-fishing industry, are expected to have a minimal effect on the Cook Inlet commercial-fishing industry. For these reasons, the relatively small contribution made by the Cook Inlet sales of discharges, offshore construction activities, and seismic surveys is expected to have no measurable additive effect on fish resources.

V.C.5.k(3) Effects of Oil Spills from OCS and State of Alaska Oil and Gas Activities

The mean number of offshore spills estimated for Alternative I is 0.21, while it is 0.58 for the cumulative analysis. The most likely number of spills from all past, present, and reasonably foreseeable future activities is zero. The estimated number of tanker spills is 0.11 for past, present, and reasonably foreseeable oil activities, and the most likely number of tanker spills for the Cook Inlet Sales 191 and 199 is zero (Table V-10). The potential effects of a 4,600-barrel spill on the commercial fishing industry were assessed in Section IV.B.1. The analysis concluded that an unlikely oil spill of this magnitude that occurred in the spring could cause State officials to close the fishery for a whole year because of tainting concerns. This action could result in a 100% loss for that year, not including losses due to damage to boats and gear. A loss of this magnitude likely would have a significant effect on the Cook Inlet and Kodiak commercial-fishing industry.

V.C.5.k(4) Effects of Sport Fishing on Commercial Fishing

Sport and commercial fishing in Alaska are managed primarily by the Alaska Department of Fish and Game, the North Pacific Management Council, and the International Pacific Halibut Commission. Seasons and harvest levels are set in much the same way for each type of fishing, although allocations and seasons differ greatly. While sport fishing for similar species is likely to affect commercial fishing, sport fishing typically occurs in different waters at different times of the year, which minimizes space-use conflicts. While there has been a recent political trend in Alaska toward the sportfishing industry, allocations for sportfishing are typically only a fraction of that allocated to the commercial-fishing industry. For this reason, sport harvests generally are considered to have much less of an effect on fish populations than those of the commercial-fishing industry. Hence, while it contributes to declines in the number of available fish, sport fishing is not likely to have a measurable cumulative effect on the commercial-fishing industry. In general, the commercial-fishing industry is affected far more by world fish-market economics (such as fish farms and dockside fish prices) and increased operating costs (often due to new regulations or restrictions) than it is by reduced stocks due to sport fishing. Because the Cook Inlet Sales 191 and 199 would have no additive effect in these areas, they are not likely to have a measurable additive effect on commercial fishing.

V.C.5.l. Subsistence-Harvest Patterns

In this section, the cumulative effects of other past, ongoing, and planned Federal and State projects in Cook Inlet, as well as the development of the prospects associated with the Cook Inlet Sale 191 on subsistence-harvest patterns are discussed. Although the chance of any or all of the planned future and ongoing offshore and onshore projects reaching developmental stages generally is unknown, this analysis assumes that all the projects discussed in this section reach the development stage. These projects could affect subsistence-harvest patterns through oil spills, noise and disturbance, drilling discharges, habitat alteration, and other factors.

V.C.5.l(1) Conclusion

Cumulative effects on subsistence-harvest patterns include effects from Sale 191 under Alternative I exploration and development activities and other past, present, and reasonably foreseeable activities affecting the Cook Inlet Region. Sources that could affect subsistence resources include potential oil spills, noise and traffic disturbance, and disturbance from construction activities associated with drilling, production facilities, pipelines, and landfalls. Subsistence communities in upper Cook Inlet, the central Kenai Peninsula, the lower Kenai Peninsula, Kodiak Island, and the southern Alaska Peninsula would potentially be most affected. Expected effects would be subsistence resources being affected for a period less than 1 year, with no resource becoming unavailable, becoming undesirable for use, or experiencing overall changes in distribution or reductions in population. In the unlikely event that a large oil spill occurred and contaminated essential subsistence resources and harvest areas, major additive (but not synergistic) significant effects could occur when impacts from contamination of the shoreline, food-tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Effects would be one or more important subsistence resources becoming unavailable or undesirable for use for at least 1-2 years or longer, which would be a significant adverse effect

V.C.5.l(2) Summary of Effects

To understand effects on subsistence-harvest patterns, we must recognize three major characteristics of regional subsistence communities:

1. they rely heavily on marine mammals and fish in the annual subsistence harvest;
2. subsistence-hunting ranges overlap for many species harvested by Native communities; and
3. subsistence hunting and fishing are central cultural values in the lifeways of the Alutiiq, Athabascan, and Koniag communities of the region.

Potential effects from oil spills, noise disturbance, and chronic cumulative biological effects could affect subsistence resources and harvests.

Access to subsistence-hunting areas and subsistence resources, as well as the use of subsistence resources, could change if oil development reduces the availability of resources or alters their distribution patterns. Cumulative effects to marine mammals are a serious concern. If increased noise, disturbance, or oil spills affect beluga whales and cause them to deflect from their normal feeding and traveling behaviors, they could be displaced from traditional hunting areas, and the traditional beluga whale harvest could be adversely affected. Any actual or perceived disruption of the beluga-whale harvest from oil spills and any actual or perceived tainting could disrupt the hunt for an entire season, even though whales might still be available. Tainting concerns also would apply to deer, bear, seals, sea lions, fish, and birds, and, of course, shellfish resources. Biological effects to subsistence resources may not affect species' distributions or populations, but disturbance could force hunters to make more frequent and longer trips to harvest enough resources in a given season.

Limited monitoring data after the *Exxon Valdez* oil spill have provided a glimpse of cumulative subsistence-resource damage; resource displacement; changes in hunter access to resources; increased competition; contamination levels in subsistence resources; harvest reductions; and issues around increased effort, risk, and cost to hunters. Studies show that in all communities dependant on subsistence, harvest levels have now returned to prespill (i.e., *Exxon Valdez* oil spill) levels. On the other hand, these same studies also indicate that some communities have abandoned hunts for certain species because those animals are more scarce, and the communities made up for the difference in this lost harvest by harvesting more animals of another resource. This has been found to be the case with sea mammals in a number of Native communities: fewer seals are harvested but more fish—usually salmon—are caught to compensate. In other communities, the response to having fewer marine mammals to harvest has been increasing the harvest effort to attain traditional harvest levels (Fall and Utermohl, 1999; Fall et al., 2001).

Proper assessment of cumulative effects in the Cook Inlet area is critical, but, overall, it is difficult to disaggregate cumulative effects of oil and other resource development in the region from the constellation of cumulative effects caused by the *Exxon Valdez* oil spill and cleanup, from ongoing spill litigation, and from the from the more general and pervasive processes of extreme local social change in the smaller villages due to the "normal" course of modernity.

V.C.5.I(3) Regional Traditional Knowledge of Cumulative Effects on Subsistence Resources and Harvest Patterns

Below are listed some of the concerns about oil development and past oil-spill effects provided by local residents and subsistence hunters of communities in the Cook Inlet region.

V.C.5.I(3)(a) Tyonek

Percy Blatchford, from Anchorage, commented:

> The Big Su River up by the power line used to be a half a mile long and 50 to 45 feet deep. Last year I went to check it out and now it is only 3 feet deep. That was where the kings and grayling used to be. I think they should close down the commercial fishing or else there is not going to be any more fish. That is all I have to say. (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

Gary Harrison, from Chickaloon, stated:

> The Feds contracted with Native hunters to kill belugas in the Inlet (Cook Inlet). They said that the Native hunters decimated the whales. When Natives complained about the lack of whales, they said that Native hunters killed them off. If they extrapolated out the number of whales killed by Native hunters, there would still be a large number of whales unaccounted for. They can't account for the lack of whales. We need to watch out for their tricks. They put Native groups against each other, but we are still friends after that. (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

V.C.5.I(3)(b) Kenai

The only change a Kenaitze resident has noticed in the abundance of seals was after the *Exxon Valdez* oil spill. She said that there are not as many seals around ("there were plenty before that"), and now they look at the livers very closely. She has observed many spotted livers, and they will not eat spotted livers. She said, "After the oil spill we looked at the liver real closely, a lot of them were spotted. We haven't gotten any from here this year. People are being careful…so damn much cancer around you have to be." She continued that 1992 was not a great year for hunting. "Something happened with that oil spill." Since the oil spill the seal population is down and they are real careful about eating them. "We had some skinny ones we didn't dare eat because they're always fat. Never get skinny ones—maybe one—but part of them last year were. Funny looking livers…. If they check them, I'd like to know what they found after the spill. If they are testing them once in a while I like to know." She said they never get information about anything. (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

V.C.5.I(3)(c) Seldovia

Lillian Elvsaas, from Seldovia, said, "I've seen some tapeworms in salmon," and "the seals in our area are less fat. Maybe this is because of lack of food." She also commented on seal livers: "The only way you can tell if there is something wrong with a liver is from the color. It seems like the liver looks as though it has collapsed and it is not full. You can just look at the liver and know that it is not good." She also expressed her thoughts about bears and the basic approach of research in general:

> That is one of the things I bought up at the tribal council. People [in Sedovia] have stopped eating the bears and they've stopped hunting it. As a community, they have stopped doing this…. They spend millions of dollars researching things that people don't consume. They could study harbor seals, which the whole state of Alaska consumes. They were worried about the sea otters. They always study something that has to do with moneymaking. Environmentalists love sea otters. Our ducks, our halibut, our resources aren't being studied. (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

A hunter in Seldovia related that since he began hunting (40 years ago, in the early 1950's), he has seen a decrease in the seal population. He blames pelt hunting in the 1960's for the decline but said the seal population is starting to take an upward swing. He also thinks that the *Exxon Valdez* oil spill probably got a lot of them (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

Another Seldovia hunter has noticed a notable decrease in the harbor seal population in the Seldovia area. He said that this decrease began about 10 years ago, before the *Exxon Valdez* oil spill. One of the local haulouts is Yukon Island, and about 10 years ago, he would see 200-300 seals hauling out on this island. This past year he only saw six or eight seals haul out there. He said the other haulouts were China Poot Bay and Indian Island. He believes that all the haulouts have decreased populations, but that the closest one (Yukon Island) has the most marked decrease. He has thought about the possibility that the seals may be moving to new haulout areas, but he has not seen any new areas. He thinks that there is a lack of feed for the seals in the area; there has been an increase in commercial, sport, and subsistence fishing over the last few years (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

A hunter in Seldovia has noticed more people from Port Graham in the Seldovia area hunting for seals and clam digging. He thinks that there are probably less seals and clams in their areas; thus, they are moving into the Seldovia area (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

V.C.5.I(3)(d) Port Graham

Lydia Robards from Port Graham said, "After the [*Exxon Valdez*] oil spill the kittiwakes acted like they were tame and people were petting them, and then they started to notice that they were spitting up blood." About continuing contamination and frustration from the spill, she stated:

> You have to go out and experience the land and the sea. Then you know there is oil underneath. The whole cycle of studies indicates that a disaster has to happen in order to study what we survive on—animals, plants, the environment. It's frustrating when Exxon comes in and says, "It's OK." The studies continue—it frustrates the Natives…. I'm thinking of the cycle. How do

> you know how to control this? We Native people knew how to handle this—our food, nourishment, fish. Like the king crab we don't see in our area anymore. Dungeness and clams too—we don't see them either. (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

A Port Graham hunter would like to see more sharing or reciprocation of information—not just on seals and sea lions but also other activities of agencies. He would like to see more local input into management decisions because he sees seals and sea lion management going the same way as sea otter management. He feels Native people could manage the resource (in cooperation with agencies) (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

Another local hunter observed that in recent years the community harvest for seals has dropped off. He could not estimate what the harvest or use might be in the future (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

Another hunter said that there used to be lots of seals in Windy Bay and close to the river mouth in Rocky Bay, especially in summer (when salmon were moving into the streams) there were lots of seal in Windy Bay. Hunters would stop on their way home from fishing down there to get seals to bring back home. Nuka Bay, Nuka Island, and Delight and Desire Lakes area also had lots of seals. During the last few years, he has not seen many seals in Windy and Rocky Bays. During the halibut season in May and June, he hasn't seen any. He said he did not see any seals on Chugach Island beach 2 years ago. He does not know about Elizabeth Island. There used to lots of seals on Yukon the island beach; however, today there are very few to be found. Last year they saw maybe 30 seals, whereas there used to be 200-300 at one time. Now they often have to go to the heads of bays like Sadie and Tutka in order to seals. (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999)

Another Port Graham hunter feels that Port Graham Bay is really lacking in food for many different animals. Species other than marine mammals such as shags and loons are on the decline in the bay. This is a sign of no food. "Murres haven't showed up here like they should if there was food for them," he said. "Herring used to be very abundant in Duncan Slough—you could get all you needed. This year there are few herring and that is why there is no king salmon. At Tutka Bay last winter there were lots of murres; one that he saw was sick, and he watched it die," he said. "Oldsquaws calling in the bay was a very significant part of the springtime animal activities which people here noticed. They used to be in big bunches singing in the spring. They were always the first to show and the last to leave. Now they are not around, maybe a few, but there is no food for them." (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999)

In 1989, the year he retired as village leader, Walter Meganack Sr. wrote a searing speech that he delivered to the Alaska Conference of Mayors, describing the effects of the *Exxon Valdez* oil spill on Port Graham:

> Of all the things that we have lost since non-Natives came to our land, we have never lost our connection with the water. The water is our source of life. So long as the water is alive, the Chugach Natives are alive….
>
> But what we see now is death. Death—not of each other, but of the source of life, the water. We will need much help, much listening in order to live through the long barren season of dead water, a longer winter than before.
>
> I am an elder. I am chief. I will not lose hope. And I will help my people. We have never lived through this kind of death. But we have lived through lots of other kinds of death. We will learn from the past, we will learn from each other, and we will live. The water is dead. But we are alive. And where there is life, there is hope" (Kizzia, 1995).

First Chief, Elenore McMullen, April 6-8, 1996, provided this written statement concerning MMS's Cook Inlet Sale 149:

> As Native people, our lives are rooted in the seasons, the water, and the ocean—we are a part of and the source of our life for years and to this day remains so. Since the Exxon Disaster, we have lost a large portion of our life—TRUST. Concern is about trust. Will our ocean and shores be

> protected? Will we be able to contain an oil spill? Will the tides in our area be taken into consideration—things move rapidly through them and spread rapidly? I oppose Lease Sale 149 or any lease sale in the Cook Inlet or Gulf of Alaska. The chances of my people benefiting from a job are possibly zero but the chances of a spill are great (Baffrey, 1996).

V.C.5.l(3)(e) Nanwalek

One hunter in Nanwalek does not feel there is anything that can be done. Close management of seals would be the worst thing, he said, because it would be too restricted; closures and seasons would prevent hunting of seals in good weather. He related this issue to the experiences with land mammal (moose and goat seasons) and salmon and halibut seasons. He fears seeing people's names in the paper and the interference of animal rights groups (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

V.C.5.l(3)(f) Akhiok

A hunter in Akhiok described how sea otter hunting was banned and "we had to sue, saying we traditionally used it. They said we didn't, and we said, 'How could we? It would have been illegal'" (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

V.C.5.l(3)(g) Karluk

A Karluk hunter stated:

> I'd seen crab in sea lion stomachs. My theories on sea lion decline: high seas drift netters, killer whales. They should check into whether sea lions migrate out at a certain time of year. Sometime in the fall or sometime in the spring, they're not there no more. You can rely on seal being there. In Chignik, sea lions will disappear and then be back again. I never went to a sea lion rookery. In the Kodiak harbor, it's easy for the sea lions to get food. Do we really know the truth? (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

Another resident of Karluk maintained that managers of sea mammals should find out what the problem is and what is making them decline. He said that Natives should have a say in subsistence. They have known their food for many years. An indigenous commission would be good, he said, if it is working for the people up north. There are a lot of people from Washington and Oregon coming to Alaska for commercial fishing, he said, and they are hard to patrol. Commercial fishermen interfere with both seals and sea lions, he said (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

V.C.5.l(3)(h) Larsen Bay

A Larsen Bay subsistence hunter related:

> I moved here in 1967. In Karluk the seals were in the Shelikof. Seals are declining—we used to see them across the bay. You never see them anymore. They're harder to get now; they have to go look around the bays. They've been declining since the oil spill. No ducks either. They used to be all over the bays. Now there's just a few. Sea lions—we only see them once in a great while inside the bays. Nobody hunts them around here (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

Another hunter estimated that between 10 and 20 seals are taken each year by the whole community.

> Twenty is the high figure, maybe it's between 10 and 15. It's a lot less than years before. Ever since the oil spill people don't go out so much. They can get other foods at the store. I get two seals a year myself if I go out [he got none last year]. (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

Observed another hunter:

> Larsen Bay Sea lions are declining in direct relation to draggers. They've declined from Little River Rock and Uyak Bay. They went down because the pollock went down. It doesn't have

> anything to do with Native hunting, just dragging. Our mainstay in summer is salmon. Draggers have made a big dent in it (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

V.C.5.l(3)(i) Old Harbor

A hunter in Old Harbor observed that when the king crab commercial harvest hit big in the early 1950's, the number of sea lions started going down at Cape Barnabus and Two-Headed Island. Dragging for crab was finally outlawed. They also noticed that gray cod fish moved in and took over when the king crab started declining. The only place to go for king crab now is Alitak and Kempoff Bay (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

V.C.5.l(3)(j) Ouzinkie

A hunter in Ouzinkie related that "we don't hunt sea lion too close to the city. My theory on why the decline in sea lions: baby sea lions aren't able to dive far under the sea. It could have to do with the oil spill. That's the main reason for the decline" (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999)

V.C.5.l(3)(k) Port Lions

A subsistence hunter in Port Lions said that "there are too many biologists, and no one listens to locals…." He also mentioned that people here will hunt for subsistence no matter what (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

V.C.5.l(3)(l) Kodiak

Julie Knagin, from Kodiak wondered about Western scientific data:

> This information is still from NOAA? How reliable is this data? You find that it is hard to evaluate and trust any information. I speak from living in Kodiak during the oil spill, and we bought a boat and the people coming in for the oil spill bought up all the food and furniture and rented all the available housing. As a result of the oil spill, the stores raised all their prices. After Exxon and VECO left, the prices still remained high. The spill affected people in more than one way…she went on to say that "We still find tar balls in Kodiak. Politicians and government tell you what you want to hear…You can't even begin to think about the damage that was done. Damage to Native people and the Native food and the lifestyles. Not only the clams and the mussels on the beaches, you take the seal and other fish in the ocean. It's pretty scary sometimes when you think about what you used to enjoy without fear and now you think twice (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

Dennis Knagin from Kodiak observed, "Supposedly everything is all clean [after the *Exxon Valdez* oil spill], but we don't eat the clams" (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

V.C.5.l(3)(m) Chignik Bay

A resident of Chignik Bay commented that that the *Exxon Valdez* oil spill did not have much of an effect on the seal populations; he felt that the seal populations were going down before the oil spill (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

A local hunter stated that sea lions primary food source, pollock, is being wiped out (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

Flore Lekanof, from Anchorage, stated: "In 1958, we used to catch king crab in Chignik off the docks, but we can't do that anymore. They are taking the crabs and the fish. We need to come up with some kind of solution" (Alaska Traditional Knowledge and Native Foods Database, Cordova Meeting, February 2000 [UAA, ISER, 2002]).

V.C.5.l(3)(n) Chignik Lagoon

One hunter remembers 30 years ago or less, when there were thousands of seals and sea lions in the Chignik area. He said: “Draggers are really wasteful. They catch anything in their way. I talked to a dragger once that had double drags, and caught 5,000-7,000 pounds of salmon a day that they had to dump because they were dragging and got herring. Sea lions get caught. On mid-water drags, the sea lions chase the fish into the net and drown” (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Div. of Subsistence, 1999).

A fisherman in Chignik Lagoon who has been fishing there since the 1960’s said there used to be a lot of sea lions at Mitrofania Island. It has been 5 years or so since he has been out there to see them. When seine fishing he has watched draggers. He said that draggers are strip mining the ocean, he said, and they throw 20% of all the catch over the side (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Division of Subsistence, 1999).

Another hunter believes that the sea lions and sea otters started to go when crab and dragger fishing started in the area. They even used seagulls for bait. This is still happening all over. The draggers and high seas driftnet fishery gets everything in their path (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Division of Subsistence, 1999).

A local hunter said that he does not see sea lions anymore. He has seen more seals; however, he has not seen that many since the oil spill. He said it has been 30 years since seals and sea lions were strong (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Division of Subsistence, 1999).

Another resident observed that when trawlers were dragging around the bays, one dragger said that they killed 25 or so sea lions in tow by Kilokak Rocks. “At the Capes, Cape Igvak, there used to be thousands of sea lions here,” he said. “Haven’t seen any there in the last 5 years, not even one.” He feels that draggers have a lot to do with it. He said:

> The Government is giving out loans for draggers, the most wasteful fishery there is. Anything that gets in the way of draggers is history. They go places where other fish can’t fish, to deeper waters. These areas are critical for many fish because it is where they spawn and grow. With draggers they don’t even have a chance to get big. They are also wiping out the bottom vegetation that provides a place to lay the eggs and food for these bottom dwellers. They aren’t just wiping out today’s fish, they are also wiping out tomorrow’s. (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Division of Subsistence, 1999).

Another Chignik Lagoon hunter fears that the sea lion problem might shut down cape fishing like around Nakchamik Island.

> The capes are major areas for seals and sea lions, and where many of the Chignik fisherman fish. But if we are forced to close down the capes, then that might put a stop to the interception conflict between Sand Point/Chignik and Kodiak fisherman. But if all Chignik fisherman were forced to fish the Lagoon, then we would all go broke. There just aren’t that many salmon returning to the Chignik River anymore, plus 100 boats fishing the Lagoon would be like rush hour in [Los Angeles]. (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Division of Subsistence, 1999).

Another resident observed:

> If they close commercial fishing because of the declining population of sea lions, then I won’t have a problem with this happening, but don’t want to be the ones that suffer or take the blame because of another fishery that is causing the real problem, wiping out stuff. The foreign fleet can't be controlled. The Russian’s used to come through our area and double trawl, wiping out tons of stuff. They have a 200 mile limit but 200 miles is nothing to a fish or sea lion. If these guys don’t have to follow the same rules as us, or aren’t being watched closely; there is nothing that we can do to counteract their destruction. (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Division of Subsistence, 1999).

Remarked another resident:

> The dragging is another destructive fishery. Worked on one once. Has anyone ever done a study on the number of draggers fishing an area in relation to the declining numbers of seals and sea lions? To those of us that have lived in this area and fished from here to Kodiak all of our lives can see there is a direct correlation to when draggers came into the area, and when marine mammals and fish stocks fell off. But we have no proof, it is just our observation. (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Division of Subsistence, 1999).

V.C.5.l(3)(o) Chignik Lake

In Chignik Lake a resident said that before the *Exxon Valdez* oil spill: "I used to see a lot of seals and used to see them on the beach [by Chignik Lake Village]. There used to be more ducks too, but they are way down. I received less ducks from hunters this year than in the past" (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Division of Subsistence, 1999).

V.C.5.l(3)(p) Perryville

In Perryville, some hunters said that they have not seen many seals since the *Exxon Valdez* spill. They said they saw dead birds and oil. One hunter said:

> [We] went out and tried to get seals. Before, we used to see them all over the beach. Now, we don't see many. In the spring we will see them traveling by. I have been finding a lot of tar balls along the beach west of here. I saw one 2 feet in diameter. All winter seeing dead birds along the beach. Another hunter has been seeing dead seagulls. I haven't noticed any that have been oiled…. Whenever we get Southeast ever since the spill, we get dead birds on shore. Tar balls coming in along the beach. See dead bird feathers in them. Finding most tar balls in kelp by Three-Star Point. Hard to collect these because the eagles and gulls get them. It would be nice to have more testing done. We're not sure how safe shellfish are. (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Division of Subsistence, 1999).

Another hunter stated:

> We haven't seen a seal around in so long. When I was a kid, I used to see lots of them. Started fading in the 80's but after the oil spill there were even fewer. From what I hear, they are moving around. I saw three last week. They are with the trout, following them into the area. There are a few sea lions around, but I haven't hunted them since [the] spill. I tried during the spill but they smelled oily. (Whiskers! Database, State of Alaska, Dept. of Fish and Game, Division of Subsistence, 1999).

V.C.5.l(4) Effects of Large Oil Spills and Disturbance on Subsistence Resources

V.C.5.l(4)(a) Cumulative Effects on Fish

The overall cumulative effect on fisheries resources may include reduced stocks of some fisheries resources (sockeye, coho, and chinook salmon, some semidemersal fish, such as pollock, and some shellfish), primarily due to the potential for over harvest of these stocks by commercial-fishing activities. This effect could persist for several generations, or longer. The Cook Inlet sale is not expected to contribute measurably to these adverse effects. While some individual subsistence fish species may be disturbed, injured, or killed, effects measurable at the population level are not likely.

V.C.5.l(4)(b) Cumulative Effects on Birds

A major source of seabird mortality in the North Pacific, including Alaskan waters, is incidental bycatch in commercial fisheries, but marine and coastal birds nesting in the Cook Inlet region probably have not been seriously affected. Introduced predators are also a serious threat to burrow-nesting seabirds on many islands. Other sources of cumulative effects on seabirds, and species important to the subsistence waterfowl hunt, include offshore oil and gas activities, vessel and air traffic, and commercial timber harvests. The effects, including direct mortality, reduced reproductive success, and habitat loss, are relatively localized, but long term. Recovery would be expected to require multiple generations and in some cases, as with declining populations, might not occur at all. The greatest risk to seabirds in the Cook Inlet region would be from an oil spill occurring during the summer (April-September) when hundreds of thousands of birds could be present in the lower Cook Inlet and northern Shelikof Strait region. If a large spill were to occur here during the summer months, thousands to tens of thousands of birds could be lost. The magnitude of mortality would depend on the size, exact timing, and movement of the spill. Recovery from this level of impact could require multiple generations, and species in population decline would not be expected to recover if this situation continued.

V.C.5.I(4)(c) Cumulative Effects on Marine Mammals

The cumulative effect on marine mammals included past commercial harvests of harbor seals that drastically reduced the species. At present, the harbor seal population in Alaska has declined in the northern and western parts of the Gulf. The cause or causes of this decline are not apparent. The greatest potential sources of cumulative effects on harbor seals, the Southcentral Alaska stock of sea otters, and other nonendangered marine mammals are commercial-fishery interactions with marine mammals and potential competition between fisheries and marine mammals for the same food resources, such as the pollock, herring, and salmon fisheries with respect to harbor seals. This competition/conflict might result in further reduced seal and other marine mammal populations that could persist for several generations in areas where there was a high commercial exploitation of fish resources.

Noise and disturbance from tourism, recreational and industrial air and vessel traffic, habitat alteration from oil exploration and development platform installation, and timber harvest log-transfer facilities are expected to have short-term displacement effects and local reduction in habitats or habitat use. These latter cumulative-effect sources may adversely affect marine mammals, such as harbor seals inhabiting coastal areas very near heavily used air- and vessel-traffic routes, or seal habitats near log-transfer facilities, but overall populations of harbor seals, and other marine mammals likely would not be affected by the latter sources of development. The contribution of Alternative I to the overall cumulative effect on marine mammals likely would include an estimated 7% of the oil and gas activity effects on coastal habitats. Some of these habitat effects could persist for more than 1 year.

The Steller sea lion population is in extreme decline and could suffer significant impacts from cumulative developments in Cook Inlet if the population decline continues or if effects on prey species were expected. Although the causes of this decline are not apparent, the greatest potential source of cumulative effects on Steller sea lions are commercial-fishery interactions with marine mammals and potential competition between fisheries and marine mammals for the same food resources.

V.C.5.I(4)(d) Cumulative Effects on Beluga Whales

Based on the best available information, it is unlikely that belugas would suffer significant population impacts from regional cumulative effects as they have already habituated to local disturbances in the Upper Inlet. Belugas tend to concentrate in the upper areas of Cook Inlet, but if the beluga whale experiences its expected future population increase in lower Cook Inlet, the potential disturbance effects to the population could come from noise and disturbance from tourism, recreational and industrial air and vessel traffic, habitat alteration from oil exploration and development platform installation, and timber harvest log-transfer facilities. These sources could produce short-term displacement effects and local reduction in habitats or habitat use.

V.C.5.I(4)(e) Cumulative Effects on Terrestrial Mammals

Habitat alteration associated with timber harvests and other onshore development is expected to have long-term effects (more than 1 to several generations) on the availability of winter forage of Sitka black-tailed deer on Afognak Island, and is expected to increase human access to brown bear habitats, leading to an increase in bear mortality (perhaps by 10%) and an overall reduction in brown bear distribution on the Kenai Peninsula and Afognak Island. Noise and disturbance associated with cumulative air, boat, and road traffic is expected to have short-term displacement effects and local, long-term (more than 1 generation) displacement effects on terrestrial mammals, especially brown bears near development facilities. This effect is directly related to human-bear encounters. Total recovery of these terrestrial mammals from losses of habitat or habitat degradation due commercial logging and other onshore development would likely take more than one to several generations.

V.C.5.I(5) Cumulative Effects of Oil Spills from OCS and State of Alaska Activities

The mean number of offshore spills increases to 0.58 under the cumulative case from 0.21 under Alternative I, but the most likely number of spills from all past, present, and reasonably foreseeable future activities is zero. The estimated number of tanker spills is 0.11 for past, present, and reasonably foreseeable oil activities and the number is zero tanker spills from the Cook Inlet Sales 191 and 199 development and production. Thus, no spills are assumed under the cumulative case (Table V-15). Potential effects of a 1,500- to 4,600-barrel spill are assessed in Section IV.C.3 under Alternative I.

V.C.5.I(6) Effects from Transportation

Cumulative effects from transportation would come from transportation of oil (1) within Cook Inlet from Drift River to the refinery at Nikiski, (2) from Valdez to the refinery at Nikiski, (3) to Far East markets, and (4) to west coast refineries. For small and large spills, the effects would be similar as those described in Sections IV.C.3 and IV.F.

For transportation to west coast refineries, we estimate Trans-Alaska Pipeline System tankering out of Valdez to contribute nine spills over a 15- to 20-year period. Of these spills, we estimate six spills of 4,000 barrels, four occurring in port and two at sea. We assume two to be 13,000 barrels, both occurring at sea. We assume a single 200,000-barrel spill at sea in the Gulf of Alaska that could extend into Cook Inlet.

In Alaskan waters, the probable oil-tanker route lies seaward of the 200-mile (322-kilometer) Exclusive Economic Zone boundary except in the northcentral Gulf of Alaska, where the transportation route leaves Prince William Sound. Oil spilled along most of this route would tend to move parallel to the Alaska Peninsula and the Aleutian Islands, rather than towards the coast, where vulnerable resource populations could be contacted. Oil spilled from a tanker after exiting Prince William Sound could contact Cook Inlet, Kodiak, and Alaska Peninsula areas. A large tanker spill of arctic oil could cause serious and long-term cumulative effects on some subsistence resources in Prince William Sound and the Gulf of Alaska, especially marine and coastal birds, sea otters, and harbor seals, with lesser effects on river otters and brown and black bears. An economic loss for 2 years following the spill to the commercial-fishing industry in this area would range from 37-64% per year and also would represent a serious loss to the subsistence fishery. Using experience from the *Exxon Valdez* oil spill as a gauge, a 200,000-barrel oil spill substantially could reduce or alter subsistence harvests for the residents of Cook Inlet, Kodiak, and Alaska Peninsula areas. In directly oil communities, especially for intertidal resources and some fish species, effects could be experienced for at least 4 years. Lesser effects of shorter duration could be expected for communities with more indirect contamination. The instantaneous nature of the event would not permit opportunistic “stocking up” of available resources. The 3,000-barrel *Glacier Bay* tanker spill in Cook Inlet in July 1987 produced no impacts to subsistence fisheries. The spill’s extent was limited to waters south of the Forelands and north of Anchor Point, and it failed to contaminate Tyonek’s subsistence fisheries in upper Cook Inlet and Port Graham and Nanwalek subsistence fisheries in lower Cook Inlet. The Alaska Department of Fish and Game, Subsistence Division contacted Native representatives in Tyonek, Port Graham, and Nanwalek who agreed that there were no subsistence fishery impacts related to the spill (Northern Economics, 1990).

Port spills would occur where contingencies for cleanup and containment are in place, and relatively, quick containment and cleanup of these in-port spills would be expected. Spills of this size at sea have not been found to cause serious effects on bird, fish, and sea mammal populations when the effects have been studied. Additionally, at-sea spills of these average sizes are not expected to reach large areas of habitat critical to these species’ survival until after the oil has been rendered less harmful by weathering and dispersion in the water. Recovery periods would be lengthened, if more than one spill affected the same population within a short interval—an unlikely situation. Therefore, effects on species along the tanker-transportation route south of the Gulf of Alaska to U.S. west coast and California ports are expected to be about the same or less than those described here, keeping in mind that there are few and limited subsistence harvests of any species along this corridor outside of Alaska. The potential for an oil spill to affect subsistence fisheries, particularly salmon, in the Pacific Northwest and the small subsistence gray whale hunt of the Makah tribe on the Washington coast along the tankering corridor, appears to be limited. LaBelle and Marshall (1995) calculated simulated oil-spill trajectories for tanker routes off the U.S. west coast. Oil-spill trajectories were mapped as "risk contours" (or oil-spill travel time at sea), showing the chance of contact to environmental resource areas, assuming an oil spill occurred (conditional probabilities). Off the California coast, an oil spill at 100 nautical miles (185 kilometers) offshore would have a 5% chance of contacting the shoreline within 30 days, while an oil spill at 80 nautical miles (148 kilometers) offshore would have a 10% chance of contacting the shoreline within 30 days. The contour lines are farther offshore off the coasts of Washington and Oregon.

V.C.5.m. Sociocultural Systems

Effects on sociocultural systems in the cumulative case are assessed in terms of past activities; current conditions (described in Section III.C.4); effects from the proposal (described in Section IV.B.1.m), and effects from the projects described in Table V-11, V-12, and V-13, which are assumed to be fully implemented. Table V-15 shows oil-spill-occurrence estimates and probabilities of one or more spills greater than 1,000 barrels resulting from Federal and State oil production and tankering in the cumulative case. Analysis of effects on sociocultural systems takes into account effects from the following:

1. the introduction of industrial activities and changes in industrial activities and community population levels,
2. changes in other aspects of the economy,
3. changes resulting from accidental spills and postspill cleanup events, and
4. effects from transportation.

V.C.5.m(1) Conclusion

The Proposed Action as part of the past, present, and reasonably foreseeable activities, should make a small, beneficial contribution to the continuation of an important economic activity which helps to maintain the existing sociocultural systems, while having little effect on Native Alaskan sociocultural practice associated with subsistence harvest activities. Given the importance of oil and gas to the Kenai Peninsula Borough and the sizeable infrastructure from past and present development, the Proposed Action will make a small contribution to the continuation of this important activity. Given the sizeable employment in the oil and gas sector, population growth caused by the reasonably foreseeable projects may be indistinguishable from the projected baseline population growth. Disruptions in existing sectors of the economy would tend to disrupt and produce stressful relations within families and within local public institutions. The reasonably foreseeable activities help maintain important existing sectors that should moderate potential disruptions from other sources. Cumulative sociocultural effects in villages that are caused by repeated significant disruption of subsistence-harvest activity and the attendant effects on wild-food consumption and distribution as the result of oil spills would be minimal. However, in the event of a significant impact to subsistence harvest activities, we would expect commensurate significant impacts to the Native Alaskan sociocultural system. Overall, the Proposed Action should have a small, beneficial effect to the continuation of an important economic and maintenance of the existing sociocultural systems without disrupting Native Alaskan sociocultural practice associated with subsistence harvest activities.

V.C.5.m(2) Incremental Contribution to Cumulative Effects from Cook Inlet OCS Sale 91

The Proposed Action contributes to the continuation of an important economic activity for the area, a positive countervailing effect, given the maturation of the industry and declining production in the area. The contribution from Cook Inlet OCS activity to adverse cumulative effects would be minimal. We expect no noticeable change in employment from the Proposed Action; rather, we estimate that much of the project-related employment will be filled by local sources. Sociocultural effects experienced by Native Alaskans are causally linked to effects to subsistence harvest patterns. According to the analysis V.C.5.o, we expect minimal cumulative effects to subsistence harvest patterns. The incremental contribution to cumulative socioeconomic effects from the Proposed Action is small, 7% based on the Proposed Action's contribution to estimated production. Since energy production is just one component of cumulative effects, the incremental contribution of the Proposed Action to total cumulative effects could be somewhat less than 7%.

V.C.5.m(3) Cumulative Effects from Other Projects and Activities

The resident population associated with the Proposed Action and proposed State oil and gas projects are expected to be situated on the Kenai Peninsula because of the location of the projects and the existence of an extensive oil- and gas-support infrastructure in the central part of the Peninsula. These projects would contribute little to overall population growth. In fact, given the importance of oil and gas to the Kenai Peninsula Borough, the contribution of these projects to population growth may be indistinguishable from projected baseline population growth. Current local residents will fill some of the jobs created by these projects. A portion of the projected population growth of the area can be allocated to new residents attracted to the area by the industry. Most of the population will reside in the Borough's cities, towns, and associated enclaves (i.e., communities and villages).

Changes in other aspects of the Southcentral Alaska economy over the life of the cumulative effects obviously would change conditions of the sociocultural systems existing there although it is unlikely that major changes would take place in cultural orientations or other social institutions. Disruptions in existing sectors of the economy, such as oil and gas production, commercial fishing, commercial sportfishing, tourism, logging, or agriculture, would tend to disrupt and produce stressful relations within families and within local public institutions. Disruption of these activities without replacement by another economic activity producing the same or greater level of wealth consistent with the values of the area could intensify the effects. Past and present activity has helped create this diversified social system. The reasonably foreseeable projects contribute to its maintenance and continuation.

V.C.5.m(4) Cumulative Effects of Oil Spills and Large Gas Releases from OCS and State of Alaska Oil and Gas Activities

The cumulative effects of oil spills on sociocultural systems would be the similar to those described for a project-related spill described in Section IV.B.1.m. These effects include alteration of existing sociocultural patterns and practices of Native Alaskans. Sociocultural effects experienced by Native Alaskans are causally linked to effects to subsistence harvest patterns. The damage to natural resources used for subsistence may result in a disruption of the connections related to harvesting, processing, and sharing subsistence resources and cultural values and the meanings about these resources. The damage affects the essential connections between sociocultural factors of individual identity, social group, culture, and nature. The greatest potential for cumulative sociocultural effects occurs in villages that experience a repeated significant disruption of subsistence-harvest activity and the attendant effects on wild-food consumption and distribution. According to the analysis of subsistence harvest practices in Section V.C.5.o, this type of disruption is not expected to occur. In the absence of this disruption, the unlikely oil spills would have little effect on the sociocultural systems.

V.C.5.m(5) Effects from Transportation

The cumulative effects due to transportation of petroleum products (1) within Cook Inlet (Drift River Oil Terminal to Nikiski), (2) from Valdez to a refinery at Nikiski, (3) to Far East markets, and (4) to the west coast derives from the effects that oil spills could have on sociocultural systems.

For transportation within Cook Inlet, the effects would be similar to those described in Section IV.B.1.m for a large spill and Section IV.F for a very large spill. While communities would need to respond to the large spill, the magnitude of the spill would not seriously affect the sociocultural systems of the region.

For transportation to west coast markets, we estimate the Trans-Alaska Pipeline System tanker operations out of Valdez could result in nine spills over a 15- to 20-year period. Of these spills, we estimate six spills of 4,000 barrels, four of which occur in port and two at sea. We assume two at 13,000 barrels, both of which occur at sea. We assume one at sea spill in the Gulf of Alaska of 200,000 barrels that could extend into Cook Inlet.

For a 200,000-barrel spill, sociocultural systems in the community of Cordova could undergo severe individual, social, and institutional stress and disruption; such a spill could last at least 4 years. Individuals and the community of Cordova that depend on income from commercial fisheries could experience stress and anxiety from debt burden, income shortfalls, litigation, and fear for the future, should the fisheries they participate in or depend on in other capacities be shortened or terminated because of the accidental spill. Individuals could also experience considerable stress and anxiety over the loss of subsistence resources, the contamination of habitat, fear of the health effects of eating contaminated wild foods, and the need to depend on the knowledge of others about environmental contamination (Impact Assessment Inc, 2001; Fall et al., 2001). Individuals and the community of Cordova would be increasingly stressed during the time needed to modify subsistence-harvest patterns by selectively changing harvest areas, if such areas were even available. Associated culturally significant activities, such as the organization of subsistence activities among kinship and friendship groups and the relationships among those that customarily process and share subsistence harvests, also would be modified or would decline.

A 200,000-barrel oil spill also would be expected to affect individuals and social systems in ways similar to the experience from the *Exxon Valdez* oil spill. As shown by that spill, some individuals found a new arena for preexisting personal and political conflict, especially over the dispensation of money and contracts. In the smaller communities, cleanup work produced a redistribution of resources, creating new schisms in the community (Impact Assessment Inc, 2001; Fall et al., 2001). Institutional effects included additional burdens being placed on local government, disruption of existing community plans and programs, strain on local officials, difficulties dealing with the spiller, community conflict, disruptions of customary habits and patterns of behavior, emotional effects and stress-related disorders, confronting environmental degradation and death, and the violation of community values (Impact Assessment Inc., 2001; Fall et al., 2001). Postspill stress resulted from this seeming loss of control over individual and institutional environments as well as from secondary episodes such as litigation, which produced secrecy over information, uncertainty over outcomes, and community segmentation.

In Alaskan waters, the probable oil-tanker route lies seaward of the 200-mile Exclusive Economic Zone boundary except in the northcentral Gulf of Alaska, where the transportation route leaves Prince William Sound. Oil spilled along most of this route would tend to move parallel to the Alaska Peninsula and the Aleutian Islands, rather than toward the coast, where vulnerable resource populations could be contacted. Oil spilled from a tanker after exiting Prince William Sound could contact the Cook Inlet, Kodiak, and Alaska Peninsula areas.

Spills could occur in ports where cleanup and containment contingencies are in place, contributing to relatively quick containment and cleanup of these in-port spills. Effects on sociocultural systems along the tanker-transportation route south of the Gulf of Alaska to west coast and California ports are expected to be reduced from those described above, primarily because Native subsistence cultures south of Alaska historically have been marginalized by the dominant culture, and there are few Native communities that continue to practice a subsistence way of life. Other potential sociocultural effects not related to Native subsistence cultures are described in the Section V.C.5.n – Reaction, Tourism, and Visual Resources.

V.C.5.n. Recreation, Tourism, and Visual Resources

This section examines the cumulative effects to recreation, tourism, and visual resources from the following:

1. current conditions, described in Section III.C.5;
2. effects from the Proposed Action, which are described in Section IV.B.1.m; and
3. effects from the projects described in Tables V-11, V-12, and V-13, which are assumed to be fully implemented.

Table V-15 shows that the Proposed Action would not increase the oil-spill-occurrence estimates and probabilities of one or more spills greater than 1,000 barrels resulting from Federal and State oil production and tankering in the cumulative case. Analysis of effects on recreation and tourism takes into account effects from the following:

1. the introduction of industrial activities and community population levels, and
2. changes resulting from accidental spills and postspill cleanup.

V.C.5.n(1) Conclusion

The contribution from Alternative 1 – Proposed Action to cumulative effects on tourism, recreation, and visual resources would be minimal and result from the introduction of offshore infrastructure from exploration and development. We estimate the incremental contribution from the Proposed Action to the cumulative effects on recreation and tourism to be approximately 7%. The industrial activities associated with the reasonably foreseeable projects, including those from the Proposed Action, would have little discernable effect on the supply or demand for recreational or tourism resources, would not modify a recreational site's characteristics (including its visual setting) or accessibility, and it would not foreclose opportunities for diversification or expansion of recreational and tourism activities. Potential population growth from the projects, which could increase demand for recreation services, would be very small. Coastal policies of the State of Alaska and the Kenai Peninsula Borough prevent new facilities from degrading recreation and tourism uses. New offshore structures in Cook Inlet would be widely separated from each other and would either be placed outside the visual impact area or become an added element to an existing cluster of platforms when viewed from shore. The projects would have no effect on the identified opportunities for expansion of tourism or recreation; they also would not aggravate the factors that would restrain the potential expansion. The cumulative effects of oil spills to recreation and tourism activities in the Cook Inlet could be significant if the area gained a reputation as being contaminated and that perception altered consumer choice of the area for recreation and tourism.

V.C.5.n(2) Incremental Contribution to Cumulative Effects from the Cook Inlet OCS Sale

For recreation, tourism, and visual resources, the incremental contribution would be the addition of a single element, the offshore production platform. The platform most likely would not displace or otherwise affect existing and anticipated uses of the area. The platform would not visible as an element in a cluster of platforms. As such, the incremental contribution of the lease sale to the cumulative effect to recreation, tourism, and visual resources should be minimal.

V.C.5.n(3) Cumulative Effects from Other Projects and Activities

Industrial activities associated with the major projects could have effects on coastal dependent or coastal enhanced recreation and tourism, if they alter the supply or demand for recreational resources, modify a recreational site's characteristics (including its visual setting) or accessibility, or if they foreclose opportunities for diversification or expansion of recreational or tourism activities.

Population growth is a robust predictor of demand for recreation, especially given the importance of outdoor-recreation opportunities to Alaskan residents and visitors. As noted in the sociocultural systems analysis in Section V.C.5.m, these projects would contribute little to overall population growth. In fact, given the importance of oil and gas to the Kenai Peninsula Borough, the contribution of these projects to population growth may be indistinguishable from the projected baseline population growth.

The onshore infrastructure, such as processing plants, generated by the project appears to be quite small. The extensive but declining offshore and onshore petroleum industry and other diverse industrial enterprises in the area coexist with a diverse and active recreation and tourism industry. Processing of crude oil and natural gas from most of the projects would take place at facilities within existing industrial areas, such as Nikiski. While the infrastructure requirements for the potential development of Tyonek Deep presently are undefined, extensive nearby development uses existing onshore facilities. State of Alaska and Kenai Borough coastal program policies require that activities that could conflict with use of designated recreational areas be conducted to minimize effects, and that facilities be sited to protect areas of particular scenic or recreational value. For example, to minimize effects, pipelines must be buried in areas of high scenic or recreational value, and existing facilities and pipeline routes must be used or consolidated when the infrastructure exists to satisfy the industrial requirement (Kenai Peninsula Borough, 1990). Therefore, it is unlikely that any onshore processing facilities or pipelines would be sited in a way that would modify the present quality or accessibility of recreation facilities or opportunities. Similarly, since project-related effects from siting of the single new offshore platform from Cook Inlet Sales 191 and 199 would not modify any recreational sites' characteristics or accessibility, it would minimally contribute to cumulative effects. If a new offshore structure is required to develop Tyonek Deep, it would add incrementally to the visual effects from a cluster of offshore facilities that have long been an element of the upper Cook Inlet view.

Changing consumer preferences also could affect recreation and tourism activities. The State of Alaska, Department of Economic and Community Development (2002) evaluated the potential for expanded recreational and tourism activities for the Kenai Peninsula Borough. The department's analysis notes that adventure travel, cultural tourism, and ecotourism are predicted to emerge as the trends in the tourism industry through the year 2020. The Kenai Peninsula has many of the resources and products needed to position itself as a destination for these tourism market segments.

Opportunities exist to develop additional cultural activities, events, and performances for visitors that highlight local culture and heritage. Further development is planned in the southern Kenai Peninsula that will add to the local supply of educational and interpretive facilities in the Kachemak Bay National Estuarine Reserve and the North Pacific Volcano Learning Center. These attractions represent modest opportunities for growth. In addition, they represent a strong opportunity to attract more visitors to the Kenai Peninsula and entice tourists to stay longer and spend more money in the communities. While not precisely defined, ecotourism focuses on the interpretation and understanding of the environment and culture of the area visited and often includes nonconsumptive adventure recreation such as canoeing, kayaking, hiking, and wildlife viewing. "Ecotourism" provides many opportunities for growth throughout the Kenai Peninsula. It is a suitable market for the rural communities that are not major tourist destinations and are seeking much needed revenue but at the same time want to retain the qualities that make their community a special place to live and visit.

Impediments to the growth of tourism include inadequate infrastructure in the western Kenai Peninsula and in other rural areas of the region. The State identified transportation-system improvements as being especially critical to the success of tourism in the western Peninsula and in some communities (such as Seldovia) in the southern Peninsula that are only accessible by boat and plane. Further growth in the region's visitor industry is hampered by the lack of affordable housing for tourism employees.

The development of the major projects considered in the cumulative analysis would be sited so that it would not interfere with or foreclose the opportunities for further tourism development. The projects' effects would not increase the impediments to tourism development. Also, the projects would not affect transportation infrastructure. As discussed in sociocultural systems in Section V.C.5.m, population growth from the projects is expected to be small and occur in cities and towns on the Peninsula rather than in the rural areas and villages.

V.C.5.n(4) Cumulative Effects of Oil Spills and Large Gas Releases from OCS and State of Alaska Oil and Gas Activities

The effects of Alternative I on recreation and tourism that could result from an oil spill are described in Section IV.B.1.n. These effects include a possible complete or partial closure of a recreation or tourism site and elimination or reduction of the coastal dependent or coastal enhanced activities for the duration of the cleanup activities at the site. Routine and accidental releases of natural gas are expected to minimally contribute to cumulative effects. Longer term effects could result if the recreation and tourism values of a site or area are perceived to be diminished, and that perception changes the consumer's preference for using that site. Cumulative impacts to recreation and tourism could result if an area gains a long-term reputation as being environmentally degraded, and that perception results in a decline in coastal dependent and coastal enhanced recreation and tourism. Sources of degradation include natural causes (i.e., fires, floods, and erosion) and human-related causes (i.e., sewage spills and oil spills). Greater magnitude or frequency of these causes could increase the perception of degradation. Events such as pipeline oil spills have occurred in the past but did not create the long-term perception of the area as being undesirable or degraded as a recreation or tourism venue. The effects from the reasonably foreseeable projects and events, including accidents, likely would not create conditions that would sustain the long-term perception of the area being degraded. Therefore, the contribution of Cook Inlet sale activities to cumulative effects on recreation and tourism from oil spills is very small.

V.C.5.n(5) Effects from Transportation

The cumulative effects from transportation of petroleum products within Cook Inlet (Drift River oil terminal to Nikiski), Valdez to refinery at Nikiski, exports to Far Eastern markets, and exports to the west coast derive from the effects that oil spills could have on recreation and tourism.

For transportation accidents within Cook Inlet, the effects would be similar to those described in Section IV.B.1.n for a large spill and Section IV.F for a very large spill. Previous transportation spills in Cook Inlet from pipeline spills and tankers, such as the *Glacier Bay*, and oil that came into the Inlet from the *S.S. Exxon Valdez*, resulted in no discernable long-term effect to the area's recreation, tourism, and visual resources or the public's preference to visit the area. Depending on the time of year and location of the spill, different recreation and tourism locations and activities other than those described in the Section IV analysis could be affected, but the impacts through the closed, partially degraded, and perceptually degraded periods following the spill would be the same. For a very large spill, the effects to recreation sites and tourism could be significant.

For transportation to west coast markets, we estimate the TAPS tanker operations out of Valdez could result in nine spills over a 15- to 20-year period. Of these spills, we estimate six spills of 4,000 barrels, four of which occur in port and two at sea. We assume two at 13,000 barrels, both of which occur at sea. We assume one at sea spill in the Gulf of Alaska of 250,000 barrels that could extend into Cook Inlet.

V.C.5.o. Sport Fisheries

V.C.5.o(1) Conclusion

We anticipate some effects from an unlikely spill greater than 1,000 barrels from Cook Inlet Sale 191 (1,500 barrels or 4,600 barrels). The loss of business due to unlikely oil spills could be 20%, or $6 million for 1 year in 2000 dollars. Oil contacting the beaches could affect clam gathering, particularly for razor clams and other types of clams for sport along the east and west sides of Cook Inlet and mussels and steamer clams in small bays off Kachemak Bay. In any area contacted by oil, populations of the intertidal organisms would be depressed measurably for about a year, and small amounts of oil would persist in the shoreline sediments for more than a decade—a significant effect. The overall cumulative effect on fisheries resources may include reduced stocks of some fisheries resources, primarily due to the potential for overharvest of these stocks by commercial-fishing activities. This effect could persist for several generations or longer. If a very large oil spill occurred in the Gulf of Alaska (such as from the Exxon Valdez – 250,000 barrels), it could drift into lower Cook Inlet and could eliminate sport fishing in Cook Inlet for 1 year. Including the total of all modes of sport fishing, 198,000 person-days of fishing could be lost for 1 year. This includes 79,000 person-days on charters in lower and central Cook Inlet; 91,000 on private or bare-boat charters; and 28,000 on shore. We estimate $35 million in 2000 dollars would be lost in 1 year. Clam gathering would be significantly affected by such a very large spill essentially the same as described in Section IV.F.3.o.

Disturbance, displacement, or injury as a result of drilling or seismic activities also would not be measurable. We estimate the various effects to sport fisheries taken altogether would not cause population-level changes in sport-fisheries resources and, consequently, in sport-fisheries activities. We anticipate no effects from the release of 5-10 million cubic feet of natural gas during exploration or 10 million cubic feet during development.

V.C.5.o(2) Incremental Contribution to Cumulative Effects from Cook Inlet OCS Sale 191

We anticipate no effects from routine activity.

There is a 19% probability of one or more spills of 1,000 barrels or greater from Sale 191. We anticipate some effects from potential spills associated with Sale 191 greater than 1,000 barrels (1,500 barrels or 4,600 barrels). The Oil-Spill-Risk Analysis model shows some probability of spilled oil contacting Land Segments along the western side of the Kenai Peninsula, which would limit the ability of sport fishers for halibut and salmon from setting out from oiled locations as long as they were oiled. The fishers could use alternate locations, but some of the charter operators would lose business. Many of the charter operators use tractors to launch their boats from the shallow beaches. The loss of business could be $6 million in 2000 dollars if the loss was 20%. Oil contacting the beaches could affect the clam gathering. People gather razor clams and clams for sport along the east and west sides of Cook Inlet and mussels and steamer clams in small bays off Kachemak Bay. In any area contacted by oil, populations of the intertidal organisms would be depressed measurably for about a year, and small amounts of oil would persist in the shoreline sediments for more than a decade. See Section IV.B.1.o – Sport Fisheries for further details of analysis. We calculate the incremental contribution of Sale 191 at 7% (see Section V.C.1 – Oil Spills and the Incremental Contribution of the Proposed Action in the Cumulative Analysis and Table V-9). The overall cumulative effect on fisheries resources may include reduced stocks of some fisheries resources, primarily due to the potential for overharvest of these stocks by commercial-fishing activities. This effect could persist for several generations, or longer. Cook Inlet Sale 191 is not expected to contribute measurably to these adverse effects. While some individual fishes may be disturbed, injured, or killed, effects measurable at the population level are not likely. Although infrequent, drilling discharges, offshore construction, and seismic surveys have been ongoing for many years in the Cook Inlet region with no measurable effect on fish populations. (See Section V.C.5.d – Fisheries Resources for more detailed analysis.)

The overall cumulative effect of permitted discharges and construction on lower trophic-level organisms likely would be negligible or immeasurable. Small spills and the cleanup responses to them probably would affect a few coastal habitats, including lower trophic-level organisms. In the few affected areas, populations of some intertidal organisms probably would be depressed measurably for about a year, and small amounts of oil would persist in shoreline sediments for more than a decade. The amount of permitted discharges and construction would not be much greater than for Cook Inlet Sale 191 alone; therefore, the effect on lower trophic-level organisms probably would be negligible or immeasurable. The cumulative effect of oil spills probably would be greater. (See Section V.C.5.c – Lower Trophic-Level Organisms for more detailed analysis.)

V.C.5.o(3) Cumulative Effects from Other Projects and Activities (Past, Present, and Future)

Section V.B describes activities considered in the cumulative-effects analysis. We find no effects from past and present activities and anticipate no effects from future activities on sport fisheries.

V.C.5.o(4) Cumulative Effects of Past, Present, and Future Oils Spills and Large Gas Releases from OCS and State of Alaska Oil and Gas Activities

Past spill records are incomplete, but the health of the Cook Inlet ecosystem currently is good. Offshore pipeline spills greater than 1,000 barrels occurred from Platforms A and B in 1966, 1967, and 1968 and ranged from 1,000-1,400 barrels. All pipeline spills were from vortex shedding because of harmonic vibration set in motion by the strong tidal currents. This problem has since been solved. Tanker spills in Cook Inlet include seven spills greater than 1,000 barrels from 1966-1989, four of which occurred near Nikiski, one near Drift River Terminal, one near Anchorage, and one near Kenai. These tanker spills were diesel fuel (two), crude oil (three), and jet fuel (two). Platform blowouts consist of three gas blowouts, occurring in 1962, 1985, and 1987. No platform oil blowouts have occurred. (See Appendix A.1 for more detail). While the above past events may seem unacceptable to some, it is important to put this past activity into perspective. These events have occurred over a 36-year period in a dynamic circulation regime dominated by tidal flushing. We believe the pipeline engineering challenges of the rigorous circulation forces in the Inlet have been solved. In addition, the numerous monitoring studies over this period have looked hard but have yielded no measurable sustained effects or degradation in the quality of the marine environment from any of these activities. See Section V.C.1 - Summary and Significance of Past Spill Events in Cook Inlet.

No large oil spills greater than 1,000 barrels from platforms or pipelines in Cook Inlet are expected in the cumulative case, except that from Sale 191 (Section V.C.1 - Differences in Cumulative Effects from Sale 191 Activities Compared to Sale 199). For effects from the oil spill in Sale 191, see V.C.5.o(2) earlier in this section. Therefore, except for the spill from Sale 191, we conclude past, present or future facility or pipeline spills have had or will have no effects on sport fisheries.

We anticipate no effects from the release of 5-10 million cubic feet of natural gas during exploration or 10 million cubic feet during development from Sale 191 or similar releases from other oil and gas exploration and development.

V.C.5.o(5) Past, Present, and Future Transportation Effects

Seven tanker spills ranging in size from 1,000-9,420 barrels occurred in Cook Inlet between 1966 and 1989 (Appendix A, Section A.1.d). One of these was the *Glacier Bay* spill in 1987. This spill was 3,095 barrels of crude. The record of the effect of the *Glacier Bay* oil spill had no effect on sport fisheries according to our best record of the effects of this spill (see Section IV.B.1.o). We have no records of the effects on sport fisheries of the other spills. The two larger spills were JP-4 or Jet A types of fuel, which would have less effect than crude because this type of fuel dissipates faster. In the years prior to 1990, there was less sportfishing than there is currently. Section V.C.1 states that past spill records are incomplete, but the health of the Cook Inlet ecosystem is good currently. Therefore, we interpret that there was no effect from these past spills on sports fisheries.

In addition to the tanker spills listed above, there are at least two documented spills from outside the Cook Inlet area that have drifted into Cook Inlet. The first spill is from an unidentified source documented by the Federal Water Pollution Control Administration (1970). The suspected source of the spill was from some tanker vessel dumping ballast and slop at sea, which used to be a common practice. No oil-spill volume is estimated. Based on the estimated number of dead birds and the length of coastline oiled, we estimate this spill was greater than or equal to 1,000 barrels. This spill affected lower Cook Inlet, including the Barren Islands, Kodiak Island, and Shelikof Strait (see Appendix A, Section A.1.d). We estimate that because this spill was about 1,000 barrels and it was in 1970 when sport fisheries in Cook Inlet were not as well developed as in the decades following, it did not affect sport fisheries.

The second documented tanker spill is the *Exxon Valdez* in 1989. This spill drifted into lower Cook Inlet. It is estimated that approximately 1-2% of the spill entered lower Cook Inlet reaching as far north as Anchor Point (see Appendix A, Section A.1.d). The entire amount of oil from the *Exxon Valdez* oil spill was 250,000 barrels; 2% of that is 5,000 barrels. From spring to fall 1989, the thin sheen of crude spread across a wide area of Cook Inlet below Anchor Point, including the area west of Homer where virtually all sport fishing charter boats harbored in 1989. Thus, these charters probably did not go out at all during that sport-fishing season in 1989. We estimate it eliminated sport fishing in Cook Inlet for 1 year. Including the total of all modes of sport fishing, 198,000 person-days of fishing would be lost for 1 year. This includes 79,000 person-days on charters in lower and central Cook Inlet; 91,000 on private or bare-boat charters; and 28,000 on shore. We estimate $35 million in 2000 dollars to be lost in 1 year. This is the total expenditure by all sport fishers fishing in lower and central Cook Inlet directly attributable to a saltwater halibut and salmon fishing. Clam gathering would be affected by such a spill as is described in Section IV.B.1.o.

Our analysis of possible future oil spills from tankering includes tankering within Cook Inlet between Drift River and Nikiski and tankering of North Slope crude oil from Valdez into Cook Inlet. Oil produced from Sale 191 would reduce proportionally the crude oil tankered to Cook Inlet from Valdez. We also analyze spills from the TAPS tankers moving oil from Valdez to the U.S. west coast for those migratory species that use the Cook Inlet basin that may come in contact with TAPS tanker spills. The most likely number of oil spills greater than or equal to 1,000 barrels from TAPS tankers is nine. We estimate six spills with an average size of 4,000 barrels, four of which occur in port and two at sea. We assume two spills, at sea each with an average size of 13,000 barrels. Finally, we assume one large, highly unlikely spill in the Gulf of Alaska of 250,000 barrels that could extend into Cook Inlet. In-port spills, where contingency measures are in place, would be cleaned up relatively quickly. Spills originating 80-100 nautical miles offshore would have a 5-10% chance of contacting the shoreline within 30 days (LaBelle and Marshall, 1995). Recent new shipping lanes and port routes have been initiated by the National Oceanic and Atmospheric Administration, which require tankers to travel at least 50 nautical miles offshore central California to better protect three marine sanctuaries of Monterey Bay, the Gulf of the Farallones, and the Channel Islands. The estimated six spills at sea and the one larger spill are not expected to occur within the same location or contact the same resources before recovery of the affected resource of the previous spill. Recovery periods would be lengthened if more than one spill affected the same population within a short interval, an unlikely situation. See Section V.C.1 - Reduction of Crude Oil Tankering from Valdez and Other Transportation Assumptions. Given these assumptions we do not anticipate effects on sport fisheries from the six spills of 4,000 barrels in port or at sea or the two spills of 13,000 barrels at sea.

In the unlikely event of a future 250,000-barrel oil spill in the Gulf of Alaska, we estimate the effects on sport fisheries would be the same as those of the *Exxon Valdez* spill described earlier in this subsection. Sport fishing occurs at many locations along the tanker route from the Gulf of Alaska to the U.S. west coast. Approximately the same effects could occur whether the spill was in the Gulf of Alaska or farther south along the Canadian or U.S. west coast bordering on the Pacific Ocean.

V.C.5.p. Environmental Justice

V.C.5.p(1) Conclusion

Cumulative effects on Environmental Justice include effects from Sale 191 exploration and development; and other past, present, and reasonably foreseeable projects. In the Cook Inlet Region, cumulative Environmental Justice effects from these actions could be experienced by low-income, minority populations in the Cook Inlet/Shelikof Strait area and would focus on the Native, subsistence-based communities of the region. Cumulative effects on these communities could occur because of their reliance on subsistence foods, and because overall cumulative effects may affect subsistence resources, subsistence-harvest practices, and sociocultural systems. Oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health. Potential cumulative effects would focus on the Native minority populations residing in the subsistence-based communities of upper Cook Inlet (Tyonek), the Central Kenai Peninsula (Ninilchik and the Kenaitze Indian population in Kenai), the lower Kenai Peninsula (Seldovia, Nanwalek, and Port Graham), Kodiak Island (Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions), and the southern Alaska Peninsula (Chignik, Chignik Lagoon, Chignik Lake, Ivanof Bay, and Perryville).

The 2000 Census "Tiger" files identify six nonsubsistence-based coastal communities on the Kenai Peninsula with median household incomes that fall below the low-income threshold. Any 2000 median household income in the Kenai Peninsula Borough below $42,650 is considered low. These communities and their 2000 median household incomes are Cohoe, $38, 542; Clam Gulch, $37,500; Ninilchik, $36,250; Happy Valley, $30,139; Nikolaevski, $37,500; and Fox River, $26,964 (see Figure IV.B-3).

Potentially, the low-income communities identified in the 2000 Census Tiger files could be disproportionately affected by accidental oil spills originating from Sale 191activities, but it must be understood that the geographical patterns of the oil and gas industry in Cook Inlet do not follow the residential distribution of low-income or minority populations in the Inlet, that is, development does not concentrate where low-income or minority populations reside.

Sources for cumulative effects include potential oil spills, noise and traffic disturbance, and disturbance from construction activities associated with drilling, production facilities, pipelines, and landfalls. In addition, habitat reduction, increased local population pressure, and increased numbers of recreational and tourism resource users have combined as cumulative factors that continue to challenge the survival of many traditional subsistence practices. Hunting patterns in Tyonek were changed in the past with the advent of logging and land clearing within their traditional hunting areas (see Fall, Foster, and Stanek, 1984). Land clearance for homesteading and farming purposes also has influenced animal distribution patterns on the Kenai Peninsula and elsewhere where practiced. Logging on the Kenai Peninsula has reduced resource habitat and subsistence harvest areas. Collectively, commercial fishing for salmon, halibut, and shellfish; guided sportfishing; resident and nonresident sportfishing; and personal-use fisheries have produced intense competition for the allocation of fisheries resources in the Cook Inlet/Kenai Peninsula area. The Kenai Peninsula is the sportfishing destination of choice for Anchorage residents, and it attracts nonresidents for personal and guided sport fishing in freshwater and saltwater environments. This commercialization of fish resources has greatly affected subsistence fishing in the past and continues to do so.

Noise and disturbance from routine activities are not expected to produce cumulative Environmental Justice impacts. The contribution of Cook Inlet lease-sale activities to cumulative effects on Environmental Justice from oil spills is very small. The most likely number of offshore oil spills (greater than or equal to 1,000 barrels) from all past, present, and reasonably foreseeable future activities and the most likely number of spills from the proposed Cook Inlet sales are both estimated to be zero. In the unlikely event that a large accidental oil spill did occur and contaminate essential subsistence resources and harvest areas, major effects on subsistence-harvest patterns and sociocultural systems would occur when impacts from contamination of the shoreline, food-tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Effects from such an event would be one or more important subsistence resources becoming unavailable or undesirable for use for 1-2 years or longer. If a spill did occur and oil the aforementioned low-income communities on the Kenai Peninsula, subsistence-related effects would be experienced because many non-Native residents supplement their diet with some subsistence resources. Nevertheless, residents of these communities would be expected to experience effects similar to the majority of residents in the Kenai Peninsula Borough.

Consequent sociocultural effects of distress, loss, and community disruption would accompany such an impact on subsistence practices. The additive subsistence and sociocultural impacts would be considered a significant adverse effect. This level of impact would be considered a disproportionate high adverse effect on Alaskan Natives. Any potential cumulative Environmental Justice effects are expected to be mitigated to some extent, though not eliminated. For a detailed discussion of Environmental Justice effects, see Sections IV.B.1.p, IV.F.3.p, and the cumulative-effects analyses for subsistence-harvest patterns and sociocultural systems in Sections V.C.5.l and V.C.5.m.

V.C.5.p(2) Additional Aspects of Environmental Justice Cumulative Impacts

The MMS acknowledges sociocultural cumulative impacts to Native subsistence-based communities in the region and that these traditional cultures have undergone significant change (see Section V.C.5.m - Sociocultural Systems). The long-term and lingering effects from the *Exxon Valdez* oil spill in 1989 have irrevocably changed the Native cultural landscape of the region. Research on long-term effects of the *Exxon Valdez* oil spill (Fall, 2001; Impact Assessment, Inc., 2001) indicate the following:

- Communities highly dependent on subsistence ("wild") foods are most vulnerable to the effects from an oil spill. In these communities, self-identities and family life are organized to a greater extent around seasonal harvest distribution and use of foods than in nonsubsistence communities. Cultural survival is tied to the traditional use of food.
- The level of distress and sense of loss increases with the proximity to the spill and the degree of oiling.
- The lingering presence of oil in the environment leads to continuing avoidance of subsistence-harvest resources.
- The short-term depression of subsistence food harvests and use did not lead to long-term sociocultural losses, such as loss of cultural knowledge, skills, or values within families. In fact, concerns about potential sociocultural effects led to intensification of economic and cultural revitalization as a social movement in communities.
- During the oil-spill cleanup, the effort of village residents was redirected away from subsistence activities to wage-sector employment. In villages, labor often is redirected between cash and noncash activities.
- The traditional organization of subsistence practices was not eroded by the spill.
- Concern over contamination of subsistence resources persists, and confidence in the benefits of eating natural foods has eroded.
- No major demographic changes occurred. Apparent outmigration of residents did not take place, neither was there a permanent inmigration. The surge of population during initial cleanup activities subsided with the winding down of cleanup.
- Purchase of lands for conservation areas caused a net loss to Native Alaskans' land base while at the same time creating certain opportunities for income and investment.

These conditions indicate that the spill did cause chronic disruption for a period of time after the spill but that existing social patterns and institutions, while affected, were not displaced. That is, the social structure of villages, towns, and cities, while profoundly affected by a large oil spill, continues to persist in the aftermath of the spill.

Although subsistence harvest levels have returned to pre-*Exxon Valdez* oil spill levels in all traditional communities of the region, some major changes have occurred in terms of types of resources harvested. More fish but fewer marine mammals are now harvested, and greater harvest effort in many cases is required to harvest the same amount of resource. Regional subsistence hunters do not feel that they have culturally and economically recovered from the event. For this reason, potential cumulative Environmental Justice effects—no matter how unlikely the chance of another large spill occurring—must still be seen in light of social and cultural disruptions that linger from the devastation of the *Exxon Valdez* oil spill (Fall and Utermohle, 1999; Fall et al., 2001; Impact Assessment, Inc., 2001).

V.C.5.q. Archaeological Resources

V.C.5.q(1) Conclusion

Exploration, development and production, and crude-oil transportation activities in the Cook Inlet Planning Area, as well as State and civilian commercial activities, would cause a cumulative effect on onshore archaeological resources that would be higher than the effects expected for the Alternative I – Proposed Action. The cumulative effects on onshore archaeological resources of other than Federal activities would be additive. No effects on offshore archaeological resources from exploration or development activities are expected to occur. However, other non-Federal activities such as bottom-trawl fishing, dredging, and anchoring may have a cumulative effect on offshore resources.

V.C.5.q(2) Cumulative Effects and Alternative I Scenario

One or more possible spills of 1,000 barrels or more resulting from Federal oil and gas production are estimated to have a 19% probability of occurring as a result of Alternative I. In addition to the Alternative I activity, existing production from Granite Point, Trading Bay, and McArthur River fields is piped ashore and is then piped to the Drift River Facility and tankered south to the U.S. west coast. The Middle Ground Shoal field is piped ashore and then piped to the Nikiski industrial complex. Alaska North Slope crude oil is tankered from Valdez to Nikiski. Associated cleanup operations related to spills from such activity could affect onshore archaeological resources to the same degree as Alternative I and would be additive. In other words, the activities of Federal cleanup operations would disturb at least 3% of the onshore resources in those areas contacted by the spill.

In addition to the cumulative effects of a spill related to Alternative I – Proposed Action, the following could have cumulative effects on archaeological and cultural resources:

- State of Alaska exploration and production in Cook Inlet and civilian commercial activities related to the lease sales also would have an effect on onshore archaeological resources, if there were spills. The effects would be similar and additive to those of the base case.
- Another possible cause of effects on onshore archaeological resources would be from the increased population due to work on any one of the wells or facilities; such workers could visit archaeological sites, either intentionally or not.
- State lease sales could have some activity that would affect resources near them or be related to the transportation of oil.
- Five existing oil and gas fields have activities that have and could in the future cause oil-transportation spills.
- The Port of Anchorage has vessels moving through Cook Inlet that could be the source of small spills.
- Military-training exercises and commercial-fishing and logging operations have been and would be sources of small spills.
- Construction activities related to these activities also could disturb onshore resources, if surveys and mitigation are not used to protect the resources. The construction of ferry terminals, small-boat harbors, coal-industry terminals, and new State of Alaska oil terminals and other water-related facilities could be the sources of disturbance to resources. These sources would disturb

resources close to the facilities constructed except in the case of transportation and support-vehicle gas and oil spills during construction.

Cumulative effects on offshore archaeological resources are expected to be minimal and could be, or have been, caused by anchor dragging, dredging, and trenching operations. It is possible that bottom trawl fishing may have disturbed and will continue to have a cumulative impact on shallow offshore archaeological resources.

V.C.5.r. National and State Parks and Other Special Areas

This section examines the cumulative effects of Alternative I to national and State parks and other special areas from the following:

- current conditions, described in Section III.C.9;
- effects from the Proposal described in Section IV.B.1.r; and
- effects from the projects described in Tables V.1-8, which are assumed to be fully implemented.

Table V-15 shows that the Proposed Action would not increase the oil-spill-occurrence estimates and probabilities of one or more spills greater than 1,000 barrels resulting from Federal and State oil production and tankering in the cumulative case. This Section's analysis takes into account effects from (1) the introduction of industrial activities and (2) changes resulting from accidental spills and postspill cleanup.

V.C.5.r(1) Conclusion

The contribution from Alternative I for Sale 191 to cumulative effects for national and State parks and other special areas would come from spilled oil and related spill-cleanup activity. The industrial and construction activities associated with the reasonably foreseeable projects would have little effect on the special areas under consideration and could be largely mitigated by the coastal management zone policies of the State of Alaska and the Kenai Peninsula Borough. These policies would prevent new facilities from degrading State and Borough parks and other special-use areas. However, the cumulative effects of an unlikely large oil spill to national and State parks and other special areas could be significant, if such a spill occurred. The public perception of damage caused by a spill could persist longer than the actual effects of the spill. The actual effects of any spilled oil generally would be the same as those forecast for the Proposed Action in Section IV.B.1.r.

V.C.5.r(2) Effects from Industrial Activities

Cumulative effects from industrial activities associated with the Proposed Action would be minimal and focused on the Kenai Peninsula. No industrial activities or industrial facilities are expected to occur on or be located on national park or refuge lands; however, the construction of a pipeline and additional oil- and gas-processing facilities may be constructed on the Kenai Peninsula. The focus of cumulative effects associated with the Proposed Action would be along the Sterling Highway corridor that is adjacent to State recreational areas that front Cook Inlet. The conflicts (or lack thereof) that may cumulatively occur during the construction and development phase of the Proposed Action would be discussed further as part of a required postsale developmental EIS. Furthermore, the Kenai Peninsula Borough coastal program policies require that industrial and other activities that could conflict with use of designated special areas be conducted to minimize effects, and that facilities be sited to protect areas of unique scenic and intrinsic value. To minimize effects, pipelines must be buried in areas of high-scenic or recreational value, and existing facilities and pipeline routes must be used or consolidated when the infrastructure exists to satisfy the industrial requirement (Kenai Peninsula Borough, 1990). Therefore, it is unlikely that any onshore processing facilities or pipelines would be sited in a way that would modify the present quality or accessibility to Borough or State park lands.

V.C.5.r(3) Effects from Oil Spills

The effects of Alternative I on national and State parks and other special areas that could result from an oil spill are described in Section IV.B.1.r. The contribution of Cook Inlet lease sale activities to cumulative effects on sociocultural systems, which include national and State parks and refuges, from oil spills is very small. The most likely number of offshore oil spills (greater than or equal to 1,000 barrels) from all past, present, and reasonably foreseeable future activities and the most likely number of spills from the proposed Cook Inlet sales is estimated to be zero.

V.C.5.r(4) Effects from Transportation

Cumulative effects due to the transportation of petroleum products would arise, principally, from tanker traffic movement within Cook Inlet (i.e., the Drift River oil terminal to Nikiski), Valdez to the refinery at Nikiski, exports to Far East markets, and exports to the west coast for transportation to west coast markets. Oil and gas resources discovered and produced by the Proposed Action would be transported to Nikiski area by pipeline and consumed in State. Therefore, it is likely that in the cumulative case the amount of oil tankered into Cook Inlet from Valdez actually may decline and, thereby, lower the overall possibility of a large spill affecting national parks and other special areas that adjoin Cook Inlet. In general, we estimate that the Trans-Alaska Pipeline System tanker operations out of Valdez could result in nine spills over a 15- to 20-year period. Of these spills, we estimate six spills of 4,000 barrels, four of which occur in port and two at sea. We assume two spills of 13,000 barrels, both of which occur at sea. We assume one at sea spill in the Gulf of Alaska of 250,000 barrels that could extend into Cook Inlet.

For transportation accidents within Cook Inlet, the effects would be similar to those described in Section IV.B.1.r for a small spill and Section IV.F for a very large spill.

In the unlikely event of a large spill along the tanker transportation route south of the Gulf of Alaska to West Coast and California ports, special areas such as marine sanctuaries, shoreside beaches, parks, campgrounds, and recreation areas could be significantly affected. Once affected by an oil-spill event, the public opinion of an area's desirability could change drastically. The public may perceive that the affected special area's intrinsic and unique values (i.e., those qualities that would have caused them to travel to the area) are lost or will take many years to return. To mitigate such an occurrence, a recent agreement between the United Nations' International Maritime Organization and the U.S. Department of Commerce has set the shipping lanes for tankers 25-30 miles offshore of the Monterey Bay, Gulf of the Farallones, and Channel Islands National Marine Sanctuaries, affording these areas greater protection from vessel collisions, groundings, and spills (CNN.com, 2000).

For tanker routes off the U.S. west coast, simulated oil-spill trajectories were calculated by LaBelle and Marshall in 1995. Oil-spill trajectories were mapped as "risk contours," showing the chance of contact to environmental resource areas over time (3-, 10-, and 30-day travel times at sea), assuming an oil spill occurred (conditional probabilities). An oil spill 100 nautical miles off the California coast would have a 5% chance of contacting the shoreline within 30 days, while an oil spill 80 nautical miles offshore would have a 10% chance of contacting the shoreline within 30 days. For Washington and Oregon, the contour lines are farther offshore. It is important to remember that tankers carrying oil from Alaska are from 100-200 miles offshore except when entering a port.

V.C.5.s. Coastal Zone Management

V.C.5.s(1) Conclusion

Cook Inlet Sale 191 is not expected to contribute measurably to the potential for conflict with the relevant policies of the Kenai Peninsula Borough and Kodiak Island Borough Coastal Management Programs or with the statewide standards of the Alaska Coastal Management Program.

V.C.5.s(2) Cumulative Effects of Other Activities

Cumulative effects may lead to changes in the level of effects to some resources. However, the Alaska Coastal Management Program Statewide standards, the relevant district policies, and the analysis of potential conflicts in Section IV remain relevant to the cumulative analysis. Although the level of effects may increase, it is expected that the activities described in the scenarios would occur in accordance with the Statewide standards and the relevant coastal district enforceable policies. Activities that occur within the boundaries of the coastal zones of the Boroughs, including their offshore coastal zones, would require permitting and approval from the appropriate Borough prior to those activities proceeding. Activities would not be approved until it is certain that such activities would not conflict with their respective coastal zone management policies. Activities outside the coastal zone with reasonably foreseeable effects on any land use, water use, or natural resource of the coastal zone of Alaska will be reviewed by the State and applicable coastal districts for consistency with the Alaska coastal management program. No permits or licenses would be issued by the MMS unless the State concurs or their objection is overridden by the Secretary of Commerce.

SECTION VI

CONSULTATION

AND

COORDINATION

CONTENTS OF SECTION VI

VI. CONSULTATION AND COORDINATION

VI.A. Development of the Proposals

The proposed Cook Inlet multiple oil and gas lease sale is one of eight proposed Outer Continental Shelf (OCS) sales discussed for Alaska and scheduled in the current (2002-2007) OCS 5-Year Oil and Gas Leasing Program. As scheduled in the Program, the Secretary of the Interior has decided to have two sales in the Alaska Region's Cook Inlet Planning Area. Sale 191 is scheduled for 2004 and Sale 199 for 2006. In keeping with the Secretary's decision, the Minerals Management Service (MMS) has modified its prelease planning and decision process and has prepared a single Environmental Impact Statement (EIS) for both Cook Inlet sales. Official coordination with other government agencies, industry, and the public regarding these proposed actions began on December 31, 2001, with a Call for Information and Nominations (Call) and Notice of Intent (NOI) to Prepare an EIS. This Call/NOI requested expressions of industry interest in blocks within the Call area and requested comments on environmental issues related to possible oil and gas leasing in the area. As a result of the Call/NOI, written comments and/or nominations were received.

Following evaluation of the area nominations and environmental information received in the process described above, together with other relevant information, the MMS submitted a recommendation for area selection to the Secretary of the Interior. On March 26, 2002, the Department of the Interior announced the area selected for further environmental study (see Section I.A for more details).

VI.B. Development of the EIS

During preparation of this and past EIS's for the Cook Inlet Planning Area, Federal, State, and local agencies; industry; and the public were consulted to obtain descriptive information, to identify significant effects and issues, and to identify effective mitigation measures and reasonable alternatives to the Proposed Action. The comments received during the scoping process for the Cook Inlet multiple-sale EIS also noted that issues raised and mitigating measures and alternatives suggested for past Cook Inlet Planning Area lease sales were relevant to the multiple sale. All of the information received has been considered in preparing the Cook Inlet multiple-sale draft EIS. In addition, scoping meetings on the Cook Inlet multiple-sale draft EIS were held in Homer, Seldovia, Ninilchik, Kenai, Kodiak, and Anchorage, Alaska, with local agencies and the public invited to identify more clearly and specifically issues and alternatives to be studied in the draft EIS. Scoping information can be found in Section I.C, and Appendix F contains the Scoping Report. Local communities, as well as departmental agencies with interest and expertise in the OCS, were consulted during the development of the potential mitigating measures for the Proposed Action.

Public hearings on the draft EIS were held in Anchorage, Seldovia, Homer and Kenai, and via teleconference. For a description of the comments process, see Section VII.

In addition, Executive Order 13175 (Consultation and Coordination with Indian Tribal Governments) states that the U.S. Government will continue "to work with Indian tribes on a government-to-government basis to address issues concerning Indian tribal self-government, trust resources, and Indian tribal treaty and other rights." To meet that direction, the MMS has met with the local tribal governments of Nanwalek, Port Graham, Seldovia, Ninilchik, and Eklutna. For a description of the government-to-government efforts, including those tribes contacted by letter and given the opportunity to participate in scoping, public comment, and the development of this EIS, see Section I.D.

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) directs each Federal Agency to consider Environmental Justice part of its mission. To meet that direction, the MMS solicited general environmental concerns and specific environmental justice concerns of low-income and minority populations in the Cook Inlet Shelikof Straight area. As described in Section I.E., this effort included community outreach during the initial scoping process, government-to-government consultation, widespread distribution of the draft EIS, public hearings that ensured the opportunity for input, and the use of previously collected input found in databases and other sources.

VI.C. Contacts for Review of the EIS

The following are the major Federal, State, and local government agencies; academic institutions; members of the oil and gas industry; special interest groups; other organizations; and private citizens who were contacted during the preparation of this EIS, or past Cook Inlet EIS's, and were sent copies of the draft EIS for review.

Federal – Executive Branch

Department of Commerce

National Marine Fisheries Service
Regional Administrator, Juneau
Alaska Regional Office, Anchorage
National Oceanic and Atmospheric Administration
Policy and Strategic Planning

Department of Defense

U.S. Army Corps of Engineers
Regulatory Branch, Alaska District
Assistant Secretary of the Navy

Department of Energy

Technical Information Center

Department of Transportation

Office of Pipeline Safety

Department of Homeland Security

United States Coast Guard

Department of the Interior

Bureau of Indian Affairs
Environmental Services
West Central Alaska Field Office
Bureau of Land Management
State Director
U.S. Fish and Wildlife Service
Federal Activities Branch
Regional Office
Anchorage Ecological Services
Fairbanks Ecological Services
Migratory Bird Management
Subsistence and Fisheries
U.S. Geological Survey
Alaska Science Center
Environmental Affairs Program
National Park Service
Regional Director
Division of Environmental Quality
Subsistence Division
Office of Environmental Policy and Compliance
Special Assistant to the Secretary for Alaska

Federal – Legislative Branch

U.S. Senate

The Honorable Lisa Murkowski
The Honorable Ted Stevens
Committee on Energy and Natural Resources
Chair
Ranking Minority Member

U.S. House of Representatives

The Honorable Don Young
Committee on Resources
Chair
Ranking Member

Federal – Administrative Agencies and Other Agencies

Marine Mammal Commission

North Pacific Fisheries Management Council

Environmental Protection Agency
Office of Federal Activities, Washington, D.C.
Region 10, NPDES Permit Unit, Seattle, WA
Alaska Operations Office, Anchorage

State of Alaska

Alaska Oil and Gas Conservation Commission

Department of Community and Economic Development

Department of Environmental Conservation

Department of Fish and Game
Region II, Habitat and Restoration
Division of Subsistence
Division of Habitat

Department of Natural Resources
Citizen's Advisory Commission on Federal Areas
Division of Geological and Geophysical Surveys
Division of Oil and Gas
Division of Water, Fairbanks

Office of the Governor
Governor
Division of Governmental Coordination
Office of Budget and Management

Local Governments

Kenai Peninsula Borough
Kodiak Island Borough
Lake and Peninsula Borough
City of Akhiok
City of Chignik
City of Homer
City of Kenai
City of Kodiak
City of Larsen Bay
City of Old Harbor
City of Ouzinke
City of Port Lions
City of Sand Point
City of Seldovia
City of Seward
City of Soldotna
City of Unalaska

Tribal Governments (Traditional and IRA Councils)

Akhiok
Chickaloon
Chignik
Chignik Lagoon
Chignik Lake
Eklutna
Ivanoff Bay
Karluk
Kenaitze
Knik
Larsen Bay
Nanwalek
Ninilchik
Old Harbor
Ouzinkie
Perryville
Port Graham
Port Lions
Salamantof
Seldovia Village
Tyonek
Unga

Native Associations and Corporations

Afognak Native Corporation
Alaska Federation of Natives
Alaska Sea Otter and Steller Sea Lion Commission
Bristol Bay Native Association
Bristol Bay Native Corporation
Chaggiung, Ltd.
Chugach Development Corporation
Chugachmuit Environmental Protection Consortium
Cook Inlet Regional Corporation
Cook Inlet Tribal Council
English Bay Native Corporation
Kodiak Area Native Association
Kodiak Tribal Council
Koniag, Inc.
Ninilchik Native Association
Old Harbor Native Association
Ouzinkie Native Corporation
Port Graham Corporation
Seldovia Native Association
The Aleut Corporation
Tyonek Native Corporation

Libraries

Alaska Pacific University, Academic Support Center Library, Anchorage
Alaska Resources Library and Information Service (ARLIS), Anchorage
Alaska State Library, Juneau
Anchor Point Library, Anchor Point
Canadian Joint Secretariat Librarian, Inuvikon NT, Canada
Chiniak Public Library, Chiniak,
Department of the Interior Library, Washington, D.C.
Department of Indian and Northern Affairs, Yellowknife, NT, Canada
Fairbanks North Star Borough, Noel Wien Library, Fairbanks
Homer Public Library, Homer
Jessie Wakefield Memorial Library, Port Lions
Johnson Memorial Library, Kodiak
Juneau Public Library, Juneau,
Kachemak Bay Campus Library, Homer
Kasilof Public Library, Kasilof
Kenai Community Library, Kenai
Kenai Peninsula College Library, Soldotna
Kodiak College Library, Kodiak,
Ninilchik Community Library, Ninilchik,
North Slope Borough School District, Library/Media Center, Barrow
Northern Alaska Environmental Center Library, Fairbanks
Old Harbor Library, Old Harbor
Ouzinkie Tribal Media Center, Ouzinkie
Seldovia Public Library, Seldovia
Soldotna Public Library, Soldotna
U.S. Army Corps of Engineers Library, Anchorage
U.S. Environmental Protection Agency, Region 10 Library, Seattle, Washington
U.S. Fish and Wildlife Service Library, Anchorage
University of Alaska Anchorage, Consortium
University of Alaska, Fairbanks
    Elmer E. Rasmuson Library
    Geophysical Institute
    Institute of Arctic Biology
University of Alaska, Southeast, Juneau
Valdez Consortium Library, Valdez
Z. J. Loussac Library, Anchorage

Interest Groups

Alaska Conservation Foundation
Alaska Crab Coalition
Alaska Fisheries Development Foundation
Alaska Marine Conservation Council
Alaska Natural Heritage Program
Alaska Public Interest Research Group
Alaska Trollers Association
American Factory Trawlers Association
Anchor Point Chamber of Commerce
Anchorage Chamber of Commerce
Arctic Connections
Area K Seiners Association
Kachemak Bay State Park Citizens Advisory Council
Kenai Chamber of Commerce
Kenai Peninsula Fisherman's Association
Kenai Sport Fishing Association
Kodiak Chamber of Commerce
Kodiak Longliners
Kodiak Regional Aquaculture Association
Kodiak Seiners
Living Resources, Inc. Fairbanks
Marine Advisory Program
National Audubon Society
National Parks and Conservation Association

Audubon Society
Center for Alaska Coastal Studies
Center for Biological Diversity
Cook Inlet Fishermen's Fund
Cook Inlet Keeper
Cook Inlet Regional Citizens Advisory Council
Defenders of Wildlife
Dragnet Fisheries
Ducks Unlimited
EarthJustice, Juneau
Exxon Valdez Oil Spill Trustee Council
Fishermen's Wives Association
Fishing Vessels Owners' Association
Greenpeace
Homer Chamber of Commerce
Indigenous Peoples Council for Marine Mammals
Kachemak Bay Conservation Association
Kachemak Bay Heritage Land Trust
Kachemak Bay Oil Reform Alliance
National Resources Defense Council
National Wildlife Federation
National Wildlife Refuge Association (CI)
Nature Conservancy
Ninilchik Chamber of Commerce
Northern Pacific Fisheries Association
Northern Pacific Fishing Vessels Owners Association
Northwest and Alaska Fisheries Center
Purse Seine Vessel Owners' Association
RurAL CAP
Sierra Club
Trustees for Alaska
United Cook Inlet Draggers Association
United Cook Inlet Drift Netters Association
United Fishermen of Alaska
University of Alaska, ENRI
Wilderness Society
Wildlife Federation of Alaska
Womens Fisheries Network

Industry

AEC Oil and Gas (USA) Inc.
Agrium
Alaska Clean Seas
Alaska Support Industry Alliance
Amerada Hess Corporation
American Petroleum Institute
Amoco Production Co.
Anadarko Petroleum Corporation
Armstrong Oil and Gas Inc.
Aspen Exploration Corporation
Atofina Petrochemicals, Inc
Aurora Gas, LLC.
B.P. Exploration (Alaska) Inc.
  Records Mgmt.
  Lands Mgr.
Chevron U.S.A. Inc.
Conoco, Inc.
Exxon Mobil Oil Corporation
Exxon Mobile Production Company
Forest Oil Corporation
Lynden Logistics
Marathon Oil Company
Murphy Exploration (Alaska), Inc.
Pennzoil
Petro-Canada (Alaska) Inc.
Phillips Alaska, Inc.
  Environmental Protection Department
Phillips Petroleum Company
Shell Frontier Oil and Gas, Inc.
Texaco Inc.
Union Oil Company of California
Western Geophysical Company

Associations, Companies, and Other Groups/Native Associations and Corporations

Afognak Native Corporation
Alaska Federation of Natives
Alaska Journal of Commerce
Alaska Marine Conservation Council
Alaska Newspapers, Inc.
Alaska Oil and Gas Association
Alaska Public Radio Network, Anchorage
Alaska Sea Otter and Steller Sea Lion Commission
Anchorage Daily News
Bristol Bay Native Association
I.H.S. Energy
Katmai Coastal Tours
Kodiak Area Native Association
Kodiak Tribal Council
Koniag, Inc.
LGL, Environmental Research
National Ocean Industries Association
Ninilchik Native Association
Oil and Gas Journal
Old Harbor Native Association

Bristol Bay Native Corporation
Chaggiung, Ltd.
Chugach Development Corporation
Chugachmuit Environmental Protection Consortium
Continental Shelf Associates
Cook Inlet RCAC
Cook Inlet Regional Corporation
Cook Inlet Tribal Council
English Bay Native Corporation
Fairbanks Daily News-Miner
Guess and Rudd P.C.
Homer News
Ouzinkie Native Corporation
Peninsula Clarion
Port Graham Corporation
Prince William Sound RCAC
SAIC, Inc.
Seldovia Native Association
Steven R. Braund and Associates
The Aleut Corporation
Tyonek Native Corporation
URS, Inc.
Waddell Marine Biotech

Individuals

Abbot, W.
Amarloca, Lee
Anderson, Ann
Anderson, Marty
Ash, Sally
Bagely, Dale
Balkus, Elizabeth
Baxter, Sera
Bayes, Ann
Beran, Donna
Beran-Maryott, Gillian
Bernoro, Chris
Bitter, Daisy Lee
Blackmer, Aggie
Brenuard, Elisabeth
Brinson, Megan
Briscoe, Martha H.
Brookman, Gerald R.
Brown, Jim
Bunce, John P.
Butler, Jim
Cacy, David
Charter, Alix
Childers, Dorothy
Clarke, Eric
Coen, Dora
Collier, Crystal
Collins, Joan
Conner, Valerie
Cook Inlet Keepers
Cooper, Joel
Cummings, Terry
Cushing, Whitney
Dean, Jack
Demello, Rick
Doddbutters, Sallie
Dodge, John C.
Du Beau, Amy
Dunn, Joan
Hitchcock, Bonnie-Sue
Holen, Anne Marie
Hort, Jeff
Houlihan, Patrick
Hrachiar, Mitchell
Hughes, Shirley
Hughes, Steve
Hundrich, Kari
Iverson, Keith
Jacob, Jr., Joseph
Janes, Mark
Jayce Brown
Jen, Mark
Johngren, Emily R
Johns, Sandy
McCarthy, Michael
Kashevaroff, Don
Kilcher, Mossy
Kleinbdor, Peggy Ellen
Kliemann, Michael W.
Knudtson, Eric
Koester, Doug
Kroll, Henry
Kvanikoff, James
Kvarford, John
Kvarford, Marly
Lakosh, Tom
Landgreer Carolina
Lane, Eileen
Lane, Lilly
Larcer, Chris
Lee, Jesse J.
Lehner, Devony
LeMay, Michael
Lentsel, Doug
Levine, Jim
Livenston, Rachel
Lusch, Mark
Lyon, Dave
Parson, Gale
Passe, Bruce
Patiro, Tania
Pennington, Hank
Peterkin II, Robert T.
Phillips, Craig
Popp, Bill
Porter, Gary
Post, Sue
Prophet, Iris
Raskin, Dale
Raskin, David
Richardson, Jeff
Richardson, Travis
Riedal, Nate
Riley, Kyra
Robertson, Tim
Ryterski, Lela
Saulitis, Eva
Schamm, William
Scott, Sachiko
Seckanice, Gregory
Segman, Dave
Seguch, Louise
Shavelson, Bob
Shawon, Bob
Smith, Hal
Soderman, Gary
Soestern, Coval
Sonen, Walt
St. John, A.D.
Stinson, Chris
Stockburger, Jean
Strydom, Mel
Stuart, Eric
Stutzer, David
Sullivan, Courtney
Swedlund, Shayla
Swenning, Emilie

Eaton, Harry
Elusano, Lillian
Elvaas, Lillian
Epstein, Lois
Espenshade, Ginny
Evans, Pricilla
Evans, Tom
Evans, Vince
Ferauds, Michael
Findlay Seaman, Barbara S.
Fitzgerald, Mary
Foedce, Maryclare
Forbes, Cameron
Forman, Tyler
Gann, Dennis
Garrison, Dave
Gavenus, Katie
Gibson, Charlie
Gilnan, Blaine
Glese, Rickey
Goslin, Paul
Graves, Cary
Greear, Alana
Greear, Marina
Griswold, Frank
Haggerty, Mako
Hecks, Dan
Hensel, Amber
Highland, Roberta
Higman, Denita
Hinstel, Michael
Hirsch, Anne
Hirsch, Brian
Martin, Maria
Matkin, Craig
Matkin, Lars
Maw, Roland
McCarthy, Catherine Anderson,
McCollum, Paul
McGrann, Amy
McGrann, Mike
McGurre, Michael
McInnes, Walter
McLay, Joel
McMullen, Deborah
McPherson, David S.
McPherson, Marla
Meganack, Riley
Meganack, Walter Jr.
Miller, Pamela A.
Miller, Pamela K.
Moffat, Alisa
Mortensen, Tom
Mumma, Susan
Nordenson, Honeybee
O'Meara, Marla D.
O'Meara, Mike
Obermeyer, Theresa
Oberstein, Sally
Oberts, Ed
Oliveira, George
Olsen, Dana
Oskoloff, Bruce
Overpeck, George
Parker, Jeanne
Parks, Alan
Tenhoff, Beke
Toms, Kathy
Tyler, R.W.
Tyler, Richard W.
Ungrue, Dan
Ungrue, Gloria
Vargas, Venus
Wagner, Neil
Ward, Emily
Warren, Phil
Watfurd, Chris
Webb, Elizabeth
Weiss, Miranda
Weller, Andrew
Welles, Luke
Welles, Stan
Wells, Roy
Wendt, Steve
Wheeler, Chris
Whitteberry, Joe
Whytal, Sharon
Williams, John
Winkler, Lindsay
Winn, Dan
Yarawsky, Sharon
Yaya, Makiko
Yeaton, Violet
Yeff, Valerie
Zacher, Terri
Zimmerman, Paul

VI.D. Contributing Authors and Supporting Staff Members

Elinore M. Anker, Editor
Albert Barros, Community Liaison
Christy Bohl, Oil Spill Contingency Plan Coordinator
Michael Burwell, Socioeconomic Specialist
Jeff Childs, Fisheries Biologist
Jim Craig, Geologist
Raymond R. Emerson, Ph.D., Environmental Special Assistant
Donald J. Hansen, Wildlife Biologist
Matt Heller, GIS Programmer/Analyst
Ken Holland, Fisheries Biologist
Tim Holder, Socioeconomic Specialist
Fred King, Chief Environmental Assessment Section, Project Manager
Steven C. Levi, Desktop Publisher
James T. Lima, Ph.D. Social Scientist and Multiple-Sale Project Coordinator
Michael McCrary, Wildlife Biologist
Ida Menge, Cartographer
Thomas Newbury, Biological Oceanographer
Richard Newman, Physical Oceanographer
Kristopher Nuttall, EAS Secretary
Mazelle O. Parker, EIS Specialist
Mark Pierson, Ph.D., Wildlife Biologist
Richard Prentki, Ph.D., Oceanographer
Lisa Rotterman, Ph.D., Wildlife Biologist
Beverly Sires, Minerals Leasing Specialist
Caryn Smith, Oceanographer
Janet Stan, Minerals Leasing Specialist
Paul Stang, Regional Supervisor, Leasing and Environment
Dennis Thurston, Geophysicist
John Tremont, Geographer
George Valiulis, Ph.D. Headquarters EIS Project Officer
Kate Wedemeyer, Fisheries Biologist

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.