Remedial Investigation Report for the

Eastern Michaud Flats Site

Part I
Executive Summary

Prepared for
FMC Corporation
J.R. Simplot Company

Copy No. ________

Bechtel Environmental, Inc.

August 1996

95-2537g.014 nt, 1

Table of Contents

Section **Page**

Section **Page**

Section **Page**

Section **Page**

Section **Page**

Section **Page**

Section **Page**

Section **Page**

Section **Page**

Appendices for Surface and Subsurface Characterizations

* Appendices U, V, W, and X appear in only selected copies of the RI Report. A diskette containing all of the data in these appendices is provided in a plastic envelope following RI report, Part II, Appendix X in all copies of the RI Report.

List of Tables

Table

Table

Table

Table

Table

Table

Table

Table

Table

Table

Table

Table

Table

List of Figures

Figure

Figure **Page**

Follows table 3.2-4

Figure

Follows table 3.3-1

Figure **Page**

Figure

Figure

Figure

Figure

Figure

Figure **Page**

Follows table 4.5-16

Follows figure 4.5-1i

Figure

Figure

Table of Contents

Section **Page**

Section **Page**

Appendices for Air Monitoring Report

List of Tables

List of Figures

Figure **Page**

Figure

Figure

Figure

Figure

Figure

Table of Contents

Appendices for Air Modeling Report

List of Tables

Table **Page**

Table **Page**

List of Figures

Figure

Figure

Figure

°C	degrees centigrade
°F	degrees Fahrenheit
µg/g	micrograms per gram
µmhos/cm	micromhos per centimeter
µmoles/g	micromoles per gram
µrem/h	microrems per hour
ADB	Arimo-Downey-Baham
AET	Apparent Effect Toxicity Threshold
AFLB	American Falls Lake Beds
AFM	Andersen Filter Media
AFR	American Falls Reservoir
ammo-phos	ammonium phosphate
AOC	Administrative Order of Consent
ASC	Additional Source Characterization
ASTM	American Society of Testing and Measurement
AVS	acid-volatile sulfide
BAPCO	Bannock Paving Company
BEI	Bechtel Environmental, Inc.
bgs	below ground surface
BLM	Bureau of Land Management
BPIP	Building Profile Input Program
CAA	Clean Air Act
CAP	capture efficiency
CE	control efficiency
CEC	cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cfs	cubic feet per second
Chester	Chester Environmental
CHV	Camelback-Hades-Valmar
CLP	Contract Laboratory Program
COPC	Constituents of Potential Concern
cps	counts per second
Cr^{+6}	hexavalent chromium

DAP	di-ammonium phosphate
DO	dissolved oxygen
DOE	Department of Energy
DQO	data quality objectives
DRR	Data recovery rate
E&E	Ecology and Environment, Inc.
EFSP	Ecological Field Sampling Plan
EIS	Environmental Impact Statement
EMF	Eastern Michaud Flats
EPA	U.S. Environmental Protection Agency
EQAPjP	Ecological Quality Assurance Project Plan
ESAP	Ecological Sampling and Analysis Plan
FDM	Fugitive dust model
FFA	FMC Facility Assessment
FMC	FMC Corporation
GEL	General Engineering Laboratories
GFAA	graphite furnace atomic absorption
gpm	gallons per minute
GPS	global positioning system
ha	hectare
HDPE	high-density polyethylene
HEAST	Health Effects Assessment Summary Tables
hi-vol	high-volume
hp	horsepower
I-86	Interstate Highway 86
ICAP	Inductively Coupled Argon Plasma Atomic Emission Spectrometry
ICP	Inductively Coupled Plasma
ID	inner diameter
IDEQ	Idaho Department of Environmental Quality
IDL	instrument detection limit
IGM	integrated gaussian model
IJ	Inkow-Joesvar
InterISC2	Inter-Industrial Source Complex 2

ISCST2	Industrial Source Complex-Short Term 2
ISU	Idaho State University
IWW	Industrial wastewater
kmph	kilometers per hour
LCS	laboratory control samples
LEC	Level of Ecological Concern
LEL	Lowest Effect Level
lo-vol	low volume
MCL	Maximum Contaminant Level
MDA	minimum detectable activity
MG	million gallons
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
milliBq	milliBecquerel
mS/cm	milliSiemens per centimeter
MSAI	Mountain States Analytical, Inc.
msl	mean sea level
mv	millivolts
MW	megawatt
Mwe	megawatt electric
NAAQS	National Ambient Air Quality Standards
NEIC	National Enforcement Investigation Center
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NWS	National Weather Service
OD	outer diameter
OMEE	Ontario Ministry of Environment and Energy
P_2O_5	phosphate
PARCC	Precision, Accuracy, Representativeness, Completeness and Comparability
PCB	polychlorinated biphenyl
pCi/l	picocuries per liter

PEI	PEDCO Environmental, Inc.
PIC	pressurized ionization chamber
PM_{10}	particulate matter of 10 microns or less
ppm	parts per million
PRV	pressure relief valve
PSD	Prevention of Significant Deterioration
PSCS	Preliminary Site Characterization Summary
PVC	polyvinyl chloride
QA/QC	Quality assurance/quality control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RRL	Riric-Rexburg-Lanoak
SAP	Sampling and Analysis Plan
SCS	U.S. Soil Conservation Service
SEM	simultaneously extracted metals
SET	source emissions tests
SII	Sciences International, Inc.
Simplot	J.R. Simplot Company
SIP	State Implementation Plan
SO_2	sulfur dioxide
SO_4	sulfate
SOP	standard operating procedures
STP	Sewage Treatment Plant
T/yr	tons per year
TAL	Target analyte list
TBD	to be determined
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TLV-TWA	threshold limit value-time weighted average
TOC	total organic carbon

TPH	total petroleum hydrocarbon
TSP	total suspended particulates
TV	tolerance values
U.S. FWS	U.S. Fish and Wildlife Service
UCL	upper confidence level
UPRR	Union Pacific Railroad
USC & GS	U.S. Coast and Geodetic Survey
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UTM	universal transverse mercator
WAC	Washington Administrative Code
XRF	x-ray fluorescence

INTRODUCTION

The Executive Summary presents the scope and findings of a Remedial Investigation (RI) performed by FMC Corporation (FMC) and J.R. Simplot Company (Simplot) at the Eastern Michaud Flats (EMF) study area. The RI was performed in accordance with the Administrative Order on Consent issued by the U.S. Environmental Protection Agency (EPA) on May 30, 1991.

This Executive Summary is organized as follows:

The EMF study area was broadly defined by the EPA to include the adjacent FMC and Simplot phosphate ore processing facilities in Pocatello, Idaho; extensive portions of the Michaud Flats and Bannock Range in the vicinity of the processing facilities; the Portneuf River, which emerges from the Pocatello Valley onto Michaud Flats east of the facilities; and portions of the American Falls Reservoir. Figure ES-1 is a map and Figure ES-2 is an aerial photograph of the EMF study area.

During the RI, FMC and Simplot performed extensive sampling and analyses of surface and subsurface soils, groundwater, surface water, sediment, aquatic and terrestrial ecology and air. More than 1,500 groundwater samples were taken and more than 60,000 analyses performed. Approximately 3,600 air samples were taken and analyzed for more than 20 constituents. A detailed emissions inventory was developed for both facilities and atmospheric dispersion models were used to characterize air emissions impacts. Industrial feedstocks and potential sources of constituent releases at both facilities were characterized and soil samples were taken to a depth of as much as 70 feet at 200 locations. Outside the processing facilities, soils were sampled on a radial grid at regular intervals along 16 compass directions up to a distance of more than 3 miles. Approximately 250 surface water and sediment samples were collected and about 7,500 analyses performed. Studies of both aquatic and terrestrial ecology were performed.

The RI adequately characterizes the nature and extent of chemical constituents that may have been released from past or current practices at the FMC and Simplot processing facilities and the potential migration of these constituents within various media.

The principal findings of the RI are described below. The summary descriptions of the nature and extent of contamination are presented in terms of the relative concentrations of site-related constituents because these constituents are naturally-occurring substances that include some background component.

SOILS

- Soils containing the highest levels of facility-related constituents are confined to the FMC and Simplot operational areas. These areas exclude residential uses.
- Although concentrations of site-related constituents are primarily elevated on properties owned by FMC and Simplot, there are offsite areas with concentrations above background levels.

GROUNDWATER

- There is no migration of site-related constituents in groundwater beyond FMC- and Simplot-owned properties. No domestic or public water supply wells are downgradient of site-impacted groundwater.
- Groundwater has concentrations of site-related constituents elevated above background beneath operational areas and extending onto adjacent company-owned properties.
- The highest constituent concentrations in groundwater are limited to areas immediately downgradient of facility sources, and concentrations decrease rapidly by advective mixing with a large volume of unaffected groundwater within FMC- and Simplot-owned properties.
- Numerical groundwater flow simulations and evaluation of hydrogeologic data indicate that the groundwater underflowing the EMF facilities is captured by facility production wells or eventually discharges to the Portneuf River through baseflow or via adjacent springs. Shallow groundwater flows northward and discharges to the Portneuf River. Deeper groundwater beneath the facilities is captured onsite by the production wells or

flows upward into the shallow aquifer where the American Falls Lake Beds are absent and also discharges to the Portneuf River.

- At the points of groundwater discharge into the Portneuf River, most mean constituent concentrations in groundwater are below background levels and all are below federal drinking water standards.
- Groundwater quality on company-owned land has and will continue to improve as a result of operational changes made by FMC and Simplot that eliminate or minimize potential migration of constituents to groundwater.

SURFACE WATER AND SEDIMENTS

- Analyses of surface water and sediment samples demonstrated that the FMC and Simplot processing facilities had no significant impact on ecological receptors associated with the Portneuf River and the American Falls Reservoir.
- Cadmium was the only analyte elevated in the Portneuf River delta sediments, compared to the Snake River delta and upstream Portneuf River sediment samples.

TERRESTRIAL ECOLOGY

- Cadmium and fluoride concentrations in vegetation collected from potentially impacted areas were elevated in comparison to those from reference locations. However, these concentrations were not high enough to result in adverse impacts to ecological receptors (e.g., mule deer) that feed on these plants. Additional factors that minimize impacts include the limited biological availability of site-related constituents and the large home range of most indigenous receptors.
- Tissue analyses performed on small mammals collected from impacted areas indicated that site-related constituent concentrations were less than concentrations known to result in adverse impacts.
- Potential impacts to top predators (e.g., red-tailed hawk) that feed on small mammals were unlikely, particularly considering factors such as limited site use by these predators and limited biological availability of site-related constituents.

AIR

- Impacts to air from emissions at the facilities are primarily on the operational areas and company-owned properties and decrease with distance from the FMC and Simplot facilities.
- Air modeling results indicate that the predominant effect on ambient air quality is associated with a few sources and constituents from the FMC and Simplot facilities.

- Emissions from the operating facilities are subject to regulation under the federal Clean Air Act.
- Recent changes in facility operations have reduced emissions from some sources. Planned changes at FMC will continue to reduce emissions from some sources.

EMF FACILITY OPERATIONS

The principal feedstock at the FMC and Simplot processing facilities is phosphate rock. The rock contains apatite, a mineral containing calcium, phosphate, and fluoride. The rock also contains trace levels of arsenic, cadmium, chromium, vanadium, zinc, uranium-238 and its daughters, and other naturally occurring elements.

FMC FACILITY

The FMC facility manufactures elemental phosphorus. The phosphate rock is crushed, conveyed and formed into briquettes. A system of baghouses is used to control air emissions from the crushing and conveying system. The briquettes are calcined to remove organic materials and water, and to form heat-hardened nodules that will withstand further processing. Calciner emissions are controlled by a series of primary and secondary wet scrubbers. The nodules are cooled and blended with coke and silica before being fed to an electric arc furnace.

High furnace temperatures drive off phosphorus and carbon monoxide. Furnace off-gases pass through electrostatic precipitators to remove dust before entering the condensers, where phosphorus is condensed into a liquid. The noncondensible carbon monoxide is used as a primary fuel and any excess is flared. Molten residues are periodically withdrawn (“tapped”) from the furnace and allowed to solidify into the by-product slag and co-product ferrophos. The slag, predominantly calcium silicate, is stockpiled at the facility. Ferrophos, an alloy of predominantly iron and phosphorus with vanadium, is periodically sold. Various lined surface impoundments are used to manage process wastewater.

Bannock Paving Company (BAPCO) operated a paving and aggregate handling facility on land leased from and adjacent to the FMC facility during the RI period. Activities periodically conducted at this facility included asphalt batching, coke drying, and slag and ferrophos crushing. Operations at BAPCO were discontinued on March 12, 1995, and BAPCO will vacate the property by December 31, 1995.

SIMPLOT FACILITY

The Simplot facility processes phosphate rock into phosphoric acid and other fertilizers. The phosphate rock is ground and slurried at the mine site and transported to the facility by pipeline. There it is reacted with sulfuric acid to produce phosphoric acid and by-product gypsum (calcium sulfate). Most of the sulfuric acid used in the process is produced at the facility by reacting sulfur with oxygen and absorbing the resultant sulfur trioxide in water.

The phosphoric acid is used to make various grades of fertilizer or is concentrated to produce stronger acids which are feedstocks to subsequent production lines. Phosphoric acid is reacted with ammonia, which is also produced at the facility, to produce various types of solid and liquid ammonium phosphate fertilizers. Ammonia and sulfuric acid are reacted to make crystalline ammonium sulfate. A system of baghouses and scrubbers are used to control air emissions.

The gypsum is slurried with water and transported to unlined gypsum stacks south of the processing facilities. The liquid fraction of the slurry is partially recovered by an underground collection system and reused in the process. Other process waters are collected and treated (pH adjustment) in a series of lined ponds. The treated water is nutrient rich and sold for irrigation/fertilization.

STUDY AREA CHARACTERISTICS

GEOLOGY AND HYDROGEOLOGY

The EMF study area is situated north and west of Pocatello, Idaho on the eastern portion of the Snake River plain. Volcanic bedrock, containing naturally occurring radioactive material, and coarse gravels underlay the study area. The general stratigraphy in the study area includes (from the bottom), volcanic bedrock units (rhyolite, tuffs, and some basalt), coarse volcanic and quartzitic gravels, fine-grained sediments of the American Falls Lake Bed, the Michaud gravels, Aberdeen alluvial terrace deposits (locally) and calcareous silts and clays. The latter surface sediments, which typically range in thickness from 10 to 40 feet within the facility areas, have an alkaline pH that neutralizes acidic solutions and precipitates metals.

Groundwater within the FMC and Simplot facilities flows from the Bannock Range foothills towards the north/northeast through unconsolidated sediments overlying the volcanic bedrock. Shallow and deep aquifer zones, separated by confining strata, are evident in the plant areas and to the north. Shallow groundwater flows into the valley where it mixes with the more prolific Michaud Flats and Portneuf River groundwater systems. The volume of groundwater flowing in the shallow zone from beneath the facilities is small compared to the flow within the thicker gravels in the valley. Groundwater within the deeper aquifer is captured by the facilities' production wells or continues northward where, in response to upward vertical gradients and the discontinuous presence of confining strata, it flows upward into the shallow aquifer. The shallow groundwater and a significant portion of the deeper groundwater underflowing the facilities discharges to the Portneuf River through Batiste Springs, Swanson Road Springs, and as baseflow to the River in the reach between these springs.

HYDROLOGY (SURFACE WATER)

The Portneuf River, which lies to the east and north, is the major surface water body near the facilities. To the south of Interstate 86, it is a losing stream. To the north of Interstate 86, it is a gaining stream fed by groundwater base flow and a system of springs. The Portneuf River flows into the American Falls Reservoir.

Rainwater which falls or flows onto the FMC and Simplot facilities is captured and controlled on-site such that there is no stormwater runoff from the facilities. The only surface water flowing from the EMF facilities is the permitted discharge of non-contact cooling water through the IWW ditch to the Portneuf River.

CLIMATE

The EMF study area is located in a semi-arid region, with approximately 11 inches of total precipitation during a year. Net annual evapotranspiration rate exceeds annual precipitation. Prevailing winds are from the southwest.

LAND USE

The EMF study area includes land belonging to the Fort Hall Indian Reservation, the Bureau of Land Management (BLM), Bannock and Power Counties, and portions of the cities of Pocatello and Chubbuck. Fort Hall Indian Reservation land use in the EMF Study Area is mainly agricultural. BLM land is designated as multiple use. Unincorporated land in Bannock and Power Counties is mostly agricultural with scattered residences. Pocatello and Chubbuck land in the study area is primarily zoned for residential use. Anticipated changes in study area land use are minimal.

In addition to the processing facilities, FMC and Simplot own all land (with the exception of road rights-of-way) between the facilities and Interstate 86, as well as substantial property just north of Interstate 86 and east of the facilities, including the Batiste Springs Property (acquired by FMC on January 9, 1996) and the Swanson Property (acquired by J.R. Simplot on May 31, 1996). The FMC and Simplot processing facilities and all other property owned by FMC and Simplot within the study area have or will be deed restricted to prohibit residential use.

ECOLOGY

Major terrestrial vegetation cover types and wildlife habitats in the EMF study area include agriculture, sagebrush steppe and wetland/riparian. Wildlife habitats in the vicinity of the EMF facilities include: sagebrush steppe, grassland, riparian, cliff and juniper woodland. No critical habitats for threatened or endangered species, or special habitats, occur in the study area.

The most significant aquatic habitats in the immediate vicinity of the EMF processing facilities are the Portneuf River and associated springs. Numerous commercial/industrial businesses and agricultural operations near the Portneuf River, both above and below the EMF site facilities, contribute constituents to the river.

SCOPE OF THE REMEDIAL INVESTIGATION

The RI consisted of extensive investigations of all relevant media (surface soils, groundwater, surface water and sediment, aquatic and terrestrial biota, and air) which identified sources of EMF-related constituents, potential pathways of migration and exposure, and receptors. The RI sampling programs and studies were designed and conducted to fully characterize the nature and extent of site-related constituents along these pathways within the EMF study area.

POTENTIAL SOURCE AND FACILITY SOIL INVESTIGATIONS

An investigation was conducted of areas which historic data and current FMC and Simplot plant operations indicated were most likely to have been potential sources of constituent releases or where placement, spillage or leakage of raw materials, by-products or process wastes (including phosphate ore, gypsum, slag, ferrophos, precipitator dust, phossy water and other pond or impoundment contents) could have occurred. In areas to which a sustained hydraulic head was applied (e.g., gypsum stacks, ponds), samples were generally collected throughout the unsaturated soil column. In areas to which no sustained hydraulic head was applied (e.g., solid product loadout areas), samples were generally collected to depths of 10 feet or less. Soil samples from over 200 locations and a total of more than 20 samples of industrial feedstocks, by-product and co-product and waste materials were analyzed. Samples were analyzed for more than 30 constituents of the phosphate ore, and for radioactivity, volatile and semi-volatile organics, total petroleum hydrocarbons, PCBs, nitrate, potassium, sulfate, pH, and the list of analytes under the toxicity characteristics leaching procedure (TCLP).

Samples of soils and water representing unimpacted areas (natural conditions) were also analyzed for these constituents. Results from these analyses were used as representative, or background levels. Results from analyses of processing facility samples were compared with representative concentrations to assess the nature and extent of site-related constituents.

At the FMC facility, the investigation included samples of the phosphate ore, stormwater, cooling water discharged to the IWW ditch, process water discharged to active ponds, sediments and sludges that came into contact with waste streams, and soils that may have been impacted by former or present processing and waste handling operations.

At the Simplot facility, the investigation included samples of the phosphate ore, aqueous discharges to water treatment ponds, gypsum slurry discharged to the gypsum stacks, sediment/sludge samples from ponds, treatment pond irrigation water, and facility soils that may have been impacted by former or present processing and waste handling operations.

SURFACE SOIL INVESTIGATION

The surface soil investigation was conducted to assess the possible effects of deposition of air emissions on surface soil at portions of the EMF study area located outside the processing facilities fencelines.

The surface soil investigation consisted of the sampling and analysis of surface and two foot deep samples along 16 radials extending out from the FMC and Simplot facilities in all directions to a distance of approximately three miles. Four sample locations were selected at regular intervals within the first mile, three locations within the second mile and two locations within the third mile.

More than 140 soil samples were analyzed for 30 constituents of phosphate ore, including metals, general minerals, radioactivity and pH. Sample concentrations were compared with background soil levels and were plotted versus distance from the facilities to assess the effect of facility air emissions on surface soil. In addition, the activities of selected radioisotopes in the naturally occurring uranium-238 decay series were compared to determine if the radioisotopes were in natural secular equilibrium with uranium-238 and, in so doing, to assess the source emissions to which EMF-related effects were most likely attributable.

Geologic and Hydrogeologic Subsurface Investigations

Geologic and hydrogeologic investigations consisted of drilling and logging 83 borings and installation and sampling of more than 130 groundwater monitoring wells adjacent to and downgradient of suspected FMC and Simplot sources of potential groundwater contamination.

Groundwater quality was evaluated by quarterly sampling over the period of the RI. Groundwater samples were analyzed for constituents of the phosphate ore and major ions. Selected samples were also analyzed for volatile and semi-volatile organics. Quarterly water level measurements were made for mapping groundwater elevations and estimating groundwater flow patterns.

In addition, slug tests were conducted in 63 wells to estimate hydraulic conductivity of individual, saturated and coarse-grained soil intervals. Aquifer pump tests were performed in four wells to provide data for calculation of hydrogeologic parameters such as transmissivity and hydraulic conductivity, and to assess lateral and vertical hydraulic interconnections. Downhole geophysical logging (gamma and temperature) was conducted in 34 wells.

A groundwater flow model was developed to support predicted local and regional groundwater budgets and flowpaths between source and discharge areas. Model output, along with water quality data, were used to estimate the fluxes of selected groundwater constituents along groundwater flowpaths.

Surface Water and Sediment Investigations

The surface water and sediment investigation was conducted to evaluate the potential effects of FMC and Simplot activities on the Portneuf River. The investigation consisted of sampling and analysis of springs, river water and sediments along a segment of the Portneuf River extending from approximately 6 miles upstream to approximately 5.5 miles downstream of the FMC and Simplot facilities.

Surface water samples were collected from more than 30 locations to provide samples upstream and downstream of the processing facilities, at seeps and springs that discharge to the Portneuf River, below outfalls or other anthropogenic discharges to the Portneuf River watershed. Surface water samples were collected on a quarterly basis for a year. Sediment samples were collected in the vicinity of the surface water sampling locations and in areas of quiet water where fine-grained sediments are most likely to have settled.

Surface water and sediment samples were analyzed for the constituents of phosphate ore as well as major ions. Results for samples collected downstream of the FMC and Simplot facilities were compared with upstream results and background groundwater and soil constituent concentrations to assess processing facility impacts on the Portneuf River. Estimates of solute fluxes at the point of groundwater discharge to the River were compared with solute flux estimates in the River upstream and downstream of the processing facilities to assess the contribution of selected constituents to the River relative to other sources.

In addition, stream flow rates were measured at selected Portneuf River locations and two spring discharges to develop a water budget for the River so that flow contributions from springs and streams along the River could be determined.

AQUATIC ECOLOGY INVESTIGATION

Two separate investigations were conducted to assess the potential impacts of site-related constituents detected in sediment samples. The first investigation focused on the Portneuf River delta located near the river’s confluence with the American Falls reservoir. Sediment samples collected from this location were analyzed for the parameters of concern. Concentrations present in the Portneuf River sediment samples were compared to concentrations measured in samples collected from upstream locations, the nearby Snake River, and to published levels of ecological concern (LEC's). The second investigation involved the collection and analysis of additional sediment samples from the Portneuf River, both upstream and downstream from the IWW ditch. Upstream samples were compared to downstream samples and to LEC's. In addition, laboratory toxicity tests were conducted to assess whether constituents present in these samples could adversely impact aquatic ecological receptors.

TERRESTRIAL ECOLOGY INVESTIGATION

The terrestrial ecology investigation consisted of sampling and analysis of co-located soils, vegetation and small mammals in the dominant native upland terrestrial ecosystem – sagebrush steppe – and in the riparian habitat bordering the Portneuf River. Sample locations ranged from 1 to 2 miles southwest of the FMC and Simplot facilities to 15 miles to the north/northeast. The samples were analyzed for cadmium, fluoride, and zinc.

Results for samples collected in areas potentially affected by the EMF facilities were compared with results for samples from reference locations. The biological availability of soil constituents was evaluated by determining tissue concentrations of constituents present in vegetation and small animals collected from the impacted area.

AIR INVESTIGATION

The air investigation consisted of an air monitoring investigation and air modeling. The air monitoring investigation consisted of sampling and analysis of ambient air at seven locations in the vicinity of the FMC and Simplot facilities for a period of 13 months. Over 3,600 samples of the particulate matter present in air were collected to characterize air quality. Three monitoring stations were located along or near the fenceline of the industrial operations areas of the facilities. Another three were placed several miles from the facilities near residential areas. The background sampling station was over 12 miles southwest of the facilities and in the prevailing upwind direction.

Samples were analyzed for more than 20 potential constituents of FMC and Simplot facility emissions, including particulate mass, metals, radionuclides, gaseous and particulate fluorides, and crystalline forms of silica. Meteorological data were collected at 2 locations for the same period.

Results for samples from locations potentially affected by the processing facilities were compared with results for samples from a background location. Sample results were also used to check air model performance.

A detailed inventory of source emissions was prepared for the FMC and Simplot processing facilities and for Bannock Paving Company, which leased property adjacent to FMC during the period of the investigation, for input into a dispersion modeling study. The inventories characterized emissions of 21 constituents from 119 point and fugitive sources. Atmospheric dispersion models specified by EPA were used to make predictions of resulting ambient air quality in the EMF study area. Air modeling predictions are estimates with inherent uncertainty.

GAMMA RADIATION STUDIES

Simplot and FMC conducted gamma radiation studies at various areas of the processing facilities to develop site-specific data relating to gamma exposure rates. Although not included in the EPA-approved RI workplan, the objective of these measurements was to characterize potential gamma radiation emitted from industrial feedstocks, by-products and wastes, and equipment shielding factors. Exposure rate measurements were obtained at over 24 locations at the Simplot facility and 63 locations at the FMC facility. Measurements were obtained using standard equipment and methods utilized in evaluating the potential need for radiation protection programs.

Exposure rates were measured under typical worker conditions (e.g., in heavy equipment cabs) or directly atop source areas (e.g., the gypsum stack and slag pile). Measurements obtained within cabs were compared to measurements obtained at the same area in the absence of the equipment to determine the shielding factor afforded by the equipment structure.

Additional measurements were obtained to characterize background exposure rates. These were collected both within the foothills of the Bannock Range south of the gypsum stack and slag pile, and in several areas of the Michaud Flats north of the industrial operations areas of the Simplot and FMC facilities.

These surveys were performed in accordance with standard methods used in measuring radiation levels under programs administered by the Occupational Health and Safety Administration (i.e., 29 CFR 1910) and the US Department of Energy. The methods used in the surveys also were consistent with those that have been developed by FMC and the Monsanto Company under a RCRA Administrative Order on Consent (AOC) with EPA Region 10. The purpose of that AOC is to provide a framework under which these companies can measure and appropriately respond to gamma radiation exposures from elemental phosphorus slag that has been used as a construction material in southeast Idaho. The first requirement of that AOC was to develop methods to accurately measure the slag-related gamma exposures. FMC and Monsanto completed that requirement, and submitted a deliverable to EPA known as the Methods Development Study Final Report that described these measurement techniques. Region 10 reviewed and approved that document. The gamma measurements that FMC and Simplot carried out at the EMF site were done in a manner consistent with the methods set forth in that EPA-approved deliverable.

SUMMARY OF FINDINGS

The nature and spatial extent of site-related constituents were characterized along all transport pathways. The findings of each phase of the RI were consistent with subsequent phases, and findings from the study of a particular medium or pathway often supported or confirmed conclusions drawn from the findings of another. Furthermore, groundwater and air dispersion models of the EMF study area developed from the RI data were consistent with the substantial volume of empirical data collected and observations made.

The groundwater study provided a check on the completeness of the facility soils study in that no constituents or constituent patterns were observed in groundwater that would suggest a major source or soil constituent had been overlooked. The adequacy of the groundwater study is supported by the consistency of the groundwater and surface water data with the conceptual model of groundwater flow.

The sufficiency of the surface water and sediment studies is evidenced by the consistency of the findings of each phase of the investigation and agreement with quantitative predictions of river water concentrations based on the model of groundwater flow.

Model-predicted average annual constituent levels compared favorably with the average annual constituent levels in the air monitoring program. The predicted levels of 15 of 18 modeled constituents met the criteria used by EPA to judge model performance. Three constituents were slightly over-predicted.

POTENTIAL SOURCES AND FMC AND SIMPLOT FACILITY SOILS

An extensive investigation of FMC and Simplot facility sources and soils was conducted to characterize the nature and extent of potential subsurface migration of facility-related constituents. The highest concentrations of constituents are in the immediate vicinity of source areas. The source areas include raw material, by-product and co-product and waste handling areas. Significant migration of site-related constituents occurs only in those areas where a sustained hydraulic head has been applied. Even in those areas, migration was limited to a few constituents. All source areas are located within the facility boundaries, and public access is restricted.

Specific potential sources and facility soils findings are as follows:

- At many unlined sources, no sustained hydraulic head has been applied. In the absence of a sustained hydraulic head, such sources have had little effect on subsurface native soils, and essentially no effect below a depth of five feet.
- In areas to which a sustained hydraulic head has been or is applied, such as in the former unlined ponds and at the gypsum stacks, native soils were sampled throughout the unsaturated zone, as much as 70 feet below the source. Even in such areas, most constituents that migrated from the source have been absorbed or precipitated within the first 10-20 feet of native soils beneath the source. Only the more soluble ions, such as sodium, potassium, sulfate, nitrate, selenium and arsenic penetrated to groundwater through native soils at sources areas underlain by silt or clay. Beneath sources underlain by coarser-grained materials, metals such as zinc and nickel exceed background levels to depths in excess of 20 feet, but were rarely above background levels near the water table. The native soils have a high capacity to absorb metals and radionuclides and to neutralize acidic seepage from the source materials.
- Since the start of the RI, FMC and Simplot have removed or reduced sustained hydraulic heads by closing unlined ponds, changing gypsum stack slurry application, and lining ponds and other areas, all of which serve to minimize the continued effects of these sources on facility soils. Seepage reductions for individual sources are estimated to be as high as 100 fold.
- Facility by-products have been used as fill in some portions of the FMC and Simplot facilities. Fill extends to depths of up to 8 feet at Simplot and up to 30 feet at FMC. Although the fill materials contain elevated levels of facility-related constituents, these materials are generally contained in fenced operational areas that are restricted from public access, although some workers at the facilities might be exposed to these materials.

SURFACE SOIL

An extensive investigation of surface soil was conducted to characterize potential deposition of facility-related constituents outside of the FMC and Simplot processing areas. The highest constituent concentrations in soil in areas outside the fenced operational areas are generally limited to properties owned by FMC or Simplot.

Specific surface soil findings are as follows:

- The highest concentrations of facility-related constituents in surface soils are found on Company-owned properties to the north and east of the industrial operation areas of the facilities. The constituents present in these soils are characteristic of phosphate ore, and it appears that windblown dusts from ore handling activities affected these soils. The principal area of accumulation lies between the operations area and Interstate 86. Constituent concentrations decrease rapidly with distance from the facilities.

- Subsurface soils have not been impacted by airborne releases, with the possible exception of several samples taken near Interstate 86 just north of the facilities, where mechanical turning of surface soils during highway construction introduced constituents into the subsurface.

GROUNDWATER

An extensive investigation of groundwater was conducted to characterize the nature and extent of potential site-related groundwater constituent concentrations. The highest concentrations in groundwater are limited to areas immediately downgradient of FMC and Simplot facility sources. Affected groundwater merges with a much larger volume of unaffected groundwater downgradient of source areas, and this mixing process, along with natural attenuation, dramatically reduces constituent levels along the groundwater flowpaths. Groundwater quality has and will continue to improve in response to changes in facility operations.

Specific groundwater findings are as follows:

- Various constituents in groundwater, including arsenic, selenium, fluoride, chloride, potassium and sulfate, exceed background levels beneath Company-owned lands in areas downgradient from several former unlined ponds and the gypsum stack. At the point of merging with the Portneuf River through springs and as baseflow, groundwater constituent concentrations consistently meet federal drinking water standards and are generally below background levels. Sulfate, nitrate and orthophosphate concentrations in groundwater are above background levels. No significant concentrations of organics were detected.
- Migration of site-related constituents from the shallow aquifer to the deeper aquifer is inhibited by upward vertical hydraulic gradients and the presence of confining strata throughout large portions of the EMF study area.
- Groundwater quality has improved and will continue to improve due to the closure of all former unlined ponds including more recently, the closure of FMC’s pond 8S, the closure of Simplot’s former east overflow pond, and changes made by Simplot regarding the manner in which slurry is applied to the gypsum stack.
- Groundwater containing site-related constituents discharges to Batiste Springs and Swanson Road Springs and to the Portneuf River in the reach encompassing these springs. The Portneuf River is an effective hydraulic barrier to shallow groundwater

flow. Impacted groundwater does not flow east of the Portneuf River. Regional groundwater flow patterns preclude westward and northward flow of site-impacted groundwater.

- There is no migration of site-related constituents to groundwater beyond FMC- and Simplot-owned properties. No domestic or public water supply wells are downgradient of site-impacted groundwater.
- Groundwater used at FMC for drinking water purposes meets federal drinking water standards.

SURFACE WATER/SEDIMENT AND AQUATIC ECOLOGY

The EMF facilities have had no measurable effect on the Portneuf River, with two exceptions: (1) there was a slight, localized increase in sulfate concentrations potentially related to influent site-affected groundwater, and (2) sediments collected at the FMC outfall were found to contain traces of phosphate ore and precipitator dust.

Specific surface water and sediment findings are as follows:

- The EMF facilities have not caused adverse impacts on surface water quality. Although surface water samples collected downstream from the facilities contain higher concentrations of sulfate, nitrate, and total phosphorus than do samples collected from upstream locations, this difference in water quality is primarily a function of non-site-related contributions (sewer treatment plant, fish farms and agricultural runoff) and regional groundwater discharge to the River. Downstream from the two facilities, the river gains water from groundwater discharges. These groundwater discharges contain higher concentrations of sulfate, nitrate and phosphate than does the Portneuf River.
- Impacted groundwater discharges at Batiste and Swanson Road springs as well as by baseflow to the Portneuf River. The average concentrations of facility-related chemicals in groundwater discharging at Batiste and Swanson Road Springs were not significantly above background groundwater levels. None of the constituents were identified at elevated levels in samples collected immediately downstream of Batiste or Swanson Road Spring.
- Groundwater models and results of analyses performed on groundwater samples predicted that potential impacts of the FMC and Simplot facilities on surface water quality were minimal. Analysis of surface water samples collected from the Portneuf River confirmed the model prediction. While the EMF facilities and other sources contribute to the elevated surface water concentrations of sulfate, nitrate, and phosphate, no adverse impacts to ecological receptors have been noted in the river.

- Cadmium was the only analyte detected at an elevated concentration in a sediment sample collected in the immediate vicinity of the IWW ditch outfall. The sampling location immediately downstream of the outfall sampling location did not contain elevated cadmium concentrations. In addition, bioassays conducted on sediment samples collected near the outfall revealed that the sediments were not toxic to test benthic organisms.
- Cadmium was the only analyte elevated in Portneuf River delta sediments, compared to both Snake River delta and upstream Portneuf River sediment samples. However, the Portneuf River delta sediment cadmium concentrations were below levels of ecological concern established by sediment bioassays, were below the concentration of a sediment sample of the IWW ditch outfall, and were not found to be toxic.

TERRESTRIAL ECOLOGY

An extensive terrestrial ecological investigation was conducted to characterize potential impacts of site-related constituents. The site-specific terrestrial ecological investigation demonstrated that concentrations of site-related constituents present in vegetation were not likely to result in adverse impacts to animals feeding on plants in the impacted area. In addition, tissue analyses indicated that small mammals were not accumulating constituents in concentrations that would result in adverse impacts to these members of the terrestrial community. The results indicated that exposures to predators that feed on these mammals are also limited.

Specific terrestrial ecology findings are as follows:

- Concentrations of cadmium, fluoride, and zinc in soil samples collected from the impacted areas were generally elevated compared to concentrations present in soils collected from reference locations.
- Cadmium and fluoride concentrations in vegetation collected from potentially impacted areas were elevated in comparison to those from reference locations. However, these concentrations were not high enough to result in adverse impacts to ecological receptors (e.g., the mule deer) that feed on these plants. Additional factors that minimize impacts are the limited biological availability of site-related constituents and the large home range of most indigenous receptors.
- Measured values for constituents present in vegetation collected from impacted areas were significantly lower than general predicted plant uptake values from a national survey, indicating that the use of general values will result in an overestimation of ecological exposures in the EMF study area.

AIR

Extensive air monitoring was performed and air dispersion models were developed to characterize the extent of potential impacts from air emissions from the facilities to ambient air quality. Impacts to air from emissions at the facilities are primarily limited to the operational areas and company-owned properties and decrease with distance from the FMC and Simplot facilities. Recent and planned changes in facility operations will reduce emissions from some sources in the future.

Specific air findings are as follows:

- FMC and Simplot facility emissions were identified as falling into three categories as follows:
    1. Fugitive emissions from feedstock and waste material handling activities including coke handling, recycled fines from the calcining process, and baghouse dust and slag disposal at FMC; and past asphalt batching, coke drying, and slag and ferrophos crushing at BAPCO.
    2. Point source emissions from process stacks including cadmium and polonium-210 sublimated in FMC's calcining process and occasional emissions of P205 from the CO flare at FMC; and total fluoride emissions from water reclaim towers at Simplot.
    3. Fugitive emissions from processes characterized as area sources including furnace tapping, slag handling and phosphorus storage at FMC.
- While emissions from other sources (e.g., roads) are less significant, these sources have been identified and characterized in the emission inventories.
- Non-EMF sources contribute a significant portion of observed concentrations of constituents detected in the ambient air quality monitoring program. Naturally occurring radon-222 decays to lead-210 which is seen in the ambient monitoring data at essentially equivalent activities up- and down-wind. Arsenic is a site-related constituent that is also present in background air samples, possibly due to naturally occurring distant sources. Particulate levels (PM_{10} and TSP) fluctuate seasonally in association with agricultural activities, snow cover, wood burning, vehicle emissions, and other sources.
- Air monitoring demonstrated that most constituents in the inhalable fraction (PM_{10}) in community areas are within the background range of concentrations or less than ambient air screening levels (EPA Region 10).
- Dispersion modeling shows a geographic area of elevated PM-10, TSP, arsenic, cadmium, total chromium, total fluoride, total phosphorus, uranium-234 and -238 in excess of

background in a crescent shaped area extending up to approximately 1,300 feet north of the operational areas. This area is predominantly within Company-owned properties. Primary sources of these constituents appear to be fugitive dust emissions from FMC material handling sources. Former BAPCO sources also contributed to this zone of impact.

- Impacts from stack emissions extend to the northeast and northwest of the facilities, beyond the crescent-shaped fugitive sources impact area. Constituents exceeding background within these areas are cadmium, polonium-210, and fluoride.
- Air model predictions of ambient air quality correlate well with monitoring data. The highest predicted annual concentrations when compared to the highest average concentrations recorded within the monitoring network were within the performance criteria specified by the EPA to judge model performance for 15 of the 18 constituents. In some instances, the model simulations both over predicted and under predicted concentrations for selected sites and constituents, but consistent biases in the predictions were not apparent. Examples of overprediction include the predictions for total chromium, nickel, and thorium in elevated terrain; and examples of underprediction include the phosphorus and cadmium predictions at several far-field sites. Within the bounds of acceptable uncertainty, the modeling methodologies can be applied as useful tools in the future to assess how ambient air quality might be affected by changes in process operations.
- Emissions from the FMC and Simplot facilities are subject to regulation under the federal Clean Air Act.
- Emissions have declined as a result of recent changes in FMC and Simplot process operations and closure of BAPCO's operations. Planned changes at FMC will continue to reduce emissions from some sources.

GAMMA RADIATION STUDIES

Average exposure rates (unshielded) within the production area of the Simplot facility were generally at or slightly above Michaud Flats background levels (facility floors, concrete and asphalt pads and other structures provide some shielding). Average exposure rates (unshielded) measured on the gypsum stack were at or below Bannock Hills background levels. Shielded exposure rates in heavy equipment used in operating the gypsum stack were lower than Bannock Hills background levels.

Average exposure rates (unshielded) near offices and several production areas of the FMC facility were within or slightly above Michaud Flats background levels (facility floors, concrete and asphalt pads and other structures provide some shielding). Average exposure rates (unshielded) measured near the ore stockpile and ore crushing area and at the slag pile were slightly above background levels. Shielded exposure rates were less than background levels in all areas except in the orestacker cab, which slightly exceeded Michuad Flats background.

An aerial radiation survey was conducted by EPA in 1987. Radiation levels reported in that survey were generally between 14.5 and 30 μrem/hr (81 to 168 mrem/yr) in the foothills, and 11 to 14.5 μrem/hr (62 to 81 mrem/yr) in the Michaud Flats. Based on the range of values indicated in the aerial survey, the average for these areas would be about 20.5 μrem per hour (115 mrem/yr). Levels measured in the residential areas of the city of Pocatello generally ranged from 14.5 to 30 μrem/hr (81 to 168 mrem/yr).

List of References

Ables, E.D., 1974. "Home Range Studies of Red Foxes (Vulpes vulpes)," J. Mammal. Vol. 50, pp. 108-120.

Allen, H.E., G. Fu, and B. Deng, 1993. "Analysis of acid-volatile sulfide (AVS) and simultaneously extracted metals (SEM) for the estimation of potential toxicity in aquatic sediments," Environmental Toxicology and Chemistry, Vol. 12, pp. 1441-1453.

American Society of Agronomy (ASA), 1982. Methods of Soil Analysis, Part 2, "Chemical and Microbiological Processes," 2nd edition, ASA, Madison, WI.

American Society for Testing and Materials (ASTM), 1993. " Standard Guide for Conducting Sediment Toxicity Tests with Freshwater Invertebrates," in: ASTM Standards on Aquatic Toxicology and Hazard Evaluation, ASTM, Philadelphia, PA, pp. 294-320.

Anderson, Carl, 1992. Personal communication between Kathleen Pahl of Bechtel Environmental, Inc., and C. Anderson of Idaho Department of Fish and Game, September 15, 1992.

Andrews, S.M., et al., 1989. "Distribution of Trace Element Pollutants in a Contaminated Grassland Ecosystem Established on Metalliferous Fluorspar Tailings", 2: Zinc," Environmental Pollution, Vol. 59A, pp. 241-252.

Ankley, G.T., et al., 1991. "Acid-volatile Sulfide as a Factor Mediating Cadmium and Nickel Bioavailability in Contaminated Sediments," Environmental Toxicology and Chemistry, Vol. 10, pp. 1299-1307.

Anwar, R.A., C.F. Langham, C. Hoppert, B.V. Alfredson, and R.O. Byerrum. 1961. "Chronic Toxicity Studies III, Chronic Toxicity of Cadmium and Chromium in Dogs," Arch. Environ. Vol. 3, pp. 456.

ACGIH, 1993. “Threshold Limit Values and Biological Exposure Indices for 1992-1993,” American Conference of Governmental Industrial Hygienists.

Aubry, K.B., 1984. "The Recent History and Present Distribution of the Red Fox in Washington," Northwest Science, Vol. 58(1), pp. 69-79.

Aulerich, R.J., et al., 1987. "Chronic Toxicity of Dietary Fluoride to Mink," Journal of Animal Science, Vol. 65, pp. 1759-1867.

Avery, D.M., 1992. "Ecological Data on Micromammals Collected by Barn Owls Tyto Alba in the West Coast Regional Park, South Africa," Israel Journal of Zoology, Vol. 38, pp. 385-397.

Baes, C.F., et al., 1984. "A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture," ORNL-5786, United States Department of Energy.

Baicor, Inc., and G.W. Miller, 1991. "Levels of Fluoride in Vegetation Samples Collected from Pocatello Areas During the 1991 Growing Season," prepared for J.R. Simplot Company, December 1991.

Bannock County Official Zoning Map, 1987. 1984 Interim Bannock County Land Use Ordinance, Pocatello, Idaho.

Barber, S.H., 1984. Nutrient bioavailability: A mechanistic approach. John Wiley and Sons, Inc., New York.

Bechtel, 1991. Draft Work Plan for an RI/FS to be Conducted at the Eastern Michaud Flats Site, Bechtel Environmental, Inc., August.

Bechtel, 1992a. “Sampling and Analysis Plan for the RI/FS Study Work Plan for the Eastern Michaud Flats Site,” Bechtel Environmental, Inc., February 1992. Amended June 1992.

Bechtel, 1992b. “Remedial Investigation/Feasibility Study Work Plan for the Eastern Michaud Flats Site,” Bechtel Environmental, Inc., June 1992.

Bechtel, 1992c. "Report of the Analysis of Pocatello, Idaho Meteorological Data for Use in Atmospheric Dispersion Modeling at the Eastern Michaud Flats Superfund Site," Bechtel Environmental, Inc., June 1992.

Bechtel, 1992d. “Data Review for Radiological Data, Project Procedure 1503.2,” Oak Ridge National Lab Remedial Investigation/Feasibility Study, Oak Ridge, TN, Bechtel Environmental, Inc., October 1992.

Bechtel, 1993a. “Air Dispersion Modeling for Monitoring Site Locations for the Eastern Michaud Flats Site,” Volumes 1 and 2, Bechtel Environmental, Inc., January 1993.

Bechtel, 1993b. "Air Pathways Monitoring Plan for the Eastern Michaud Flats Site," Bechtel Environmental, Inc., February 1993.

Bechtel, 1993c. “Remedial Investigation/Feasibility Study Phase II Site Investigation Plan for the Eastern Michaud Flats Site,” Bechtel Environmental, Inc., March 1993.

Bechtel, 1993d. “RI/FS Data Dictionary for the Eastern Michaud Flats Site,” Bechtel Environmental, Inc., August 1993.

Bechtel, 1993e. "Revisions to the Air Pathways Monitoring Plan for the Eastern Michaud Flats Site," Bechtel Environmental, Inc., September 10, 1993.

Bechtel, 1993f. "Standard Operating Procedures for the Eastern Michaud Flats Site," Bechtel Environmental, Inc., November 1993.

Bechtel, 1993g. "RCRA Interim Status 1992 Groundwater Monitoring Assessment," Bechtel Environmental, Inc., January 1994.

Bechtel, 1994a. "Preliminary Site Characterization Summary for the Eastern Michaud Flats Site," Bechtel Environmental, Inc., January 1994.

Bechtel, 1994b. "EMF Air Pathways Monitoring Report for the October 1993 Sampling Period," Eastern Michaud Flats at Pocatello, Idaho, Bechtel Environmental, Inc., January 1994.

Bechtel, 1994c. "EMF Air Pathways Monitoring Report for the November 1993 Sampling Period," Eastern Michaud Flats at Pocatello, Idaho, Bechtel Environmental, Inc., May 1994.

Bechtel, 1994d. "EMF Air Pathways Monitoring Report for the December 1993 Sampling Period," Eastern Michaud Flats at Pocatello, Bechtel Environmental, Inc., Idaho, May 1994.

Bechtel, 1994e. "Air Pathways Quality Assurance Project Plan for the Eastern Michaud Flats Site," Bechtel Environmental, Inc., May, 1994.

Bechtel, 1994f. "Air Pathways Monitoring Program Standard Operating Procedures for the Eastern Michaud Flats Site," Bechtel Environmental, Inc., May, 1994.

Bechtel, 1994g. "EMF Air Pathways Fall 1993 Data Interpretation Report for the Eastern Michaud Flats Site," Bechtel Environmental, Inc., June 1994.

Bechtel, 1994h. "EMF Air Pathways Monitoring Report for the January 1994 Sampling Period," Eastern Michaud Flats at Pocatello, Idaho, Bechtel Environmental, Inc., July 1994.

Bechtel, 1994i. "Meteorological Data Acquisition Plan for the Eastern Michaud Flats Site," Bechtel Environmental, Inc., July 1994.

Bechtel, 1994j. "EMF Air Pathways Monitoring Report for the February, March, April, May, and June 1994 Sampling Period," Eastern Michaud Flats at Pocatello, Idaho, Bechtel Environmental, Inc., August 1994.

Bechtel, 1994k. "Characterization of Ambient Air Quality in the EMF Study Area," Bechtel Environmental, Inc., September, 1994.

Bechtel, 1994l. "Ecological Quality Assurance Project Plan," Bechtel Environmental, Inc., September, 1994.

Bechtel, 1994m. "Ecological Field Sampling Plan," Bechtel Environmental, Inc. October 1994.

Bechtel, 1994n. "RCRA Interim Status 1993 Groundwater Monitoring Assessment," Bechtel Environmental, Inc., February 1994.

Bechtel, 1995. "RCRA Interim Status 1993 Groundwater Monitoring Assessment," Bechtel Environmental, Inc., February 1995.

Bednarz, J.C. and J.J. Dinsmore., 1982. "Nest-sites and Habitat of Red-shouldered and Red-tailed Hawks in Iowa," Wilson Bull. 94: 31-45.

Benkley and Schulman, 1979. Estimating hourly mixing height from historical meteorological data by Benkley, Carl W. and Schulman, L., presented in the *Journal of Applied Meteorology,* Vol. 18, June 1979, pp. 772-780

Bent, A.C., 1937. "Life Histories of North American Birds of Prey," U.S. National Museum Bulletin Number 167, Part 1, Washington, DC.

Bent, A.C., 1938. "Life Histories of North American Birds of Prey," U.S. National Museum Bulletin Number 170, Part 2, Washington, DC.

Bohm, R.T., 1978a. "Observation of Nest Decoration and Food Habits of Red-Tailed Hawks," Loon Vol. 50, pp. 6-8.

Bohm, R.T., 1978b. "A Study of Nesting Red-Tailed Hawks in Central Minnesota," Loon 50: 129-137.

Boulton IC, Cooke JA, Johnson MS. 1994. Experimental fluoride accumulation and toxicity in short-tailed field vole (Microtus agrestis). J of Zoology 234(3):409-421.

Brock, J. T., 1989. "Possible Effects of Pocatello's Treated Wastewater on the Biology and Chemistry of the Portneuf River, in City of Pocatello, 1989." Assessment of Possible Effects of Pocatello's Treated Wastewater on the Biology and Chemistry of the Portneuf River, Pocatello, Idaho. Final Report, pp. 2-1 to 2-19, November 1989.

Broderick, S. C., D. M. Daley, F. L. Greider, and R. Haskett, 1989. "Assessment of Possible Effects of Wastewater Treatment Plant Effluent on Fish Distribution in the Portneuf River, in City of Pocatello, 1989." Assessment of Possible Effects of Pocatello's Treated Wastewater on the Biology and Chemistry of the Portneuf River. Final Report, November 1989.

Brown, L. and D. Amadon, 1968. Eagles, Hawks, and Falcons of the World: v. 1. McGraw-Hill, New York.

Buikema, Arthur L. Jr., 1975. “Final Report for Macrobenthos Study of the Portneuf River,” prepared for FMC Corporation, Industrial Chemical Division, Pocatello, Idaho, August 22, 1975.

Buttelman, Dave, 1992a. Personal communication between Kathleen Pahl of Bechtel and D. Buttelman, FMC, October 22, 1992.

Buttelman, Dave, 1992b. Personal correspondence between Dave Buttelman of FMC Corporation and Howard Hammeren of Bechtel Environmental, Inc., October 1992.

Buttelman, Dave, 1992c. Personal correspondence between Dave Buttelman of FMC Corporation and Marcey Manning of Bechtel Environmental, Inc.

Cain, B.W., J.C. Sileo, J.C. Franson, and J. Moore, 1983. "Effects of Dietary Cadmium on Mallard Ducklings," Environ. Res. Vol. 32, pp. 286-297.

Campbell, T., S. Wood, R. James, R. Rodriquez, and G. Arcand, 1992. “An Evaluation of the Concentration of Orthophosphate in the Portneuf River, Idaho,” Journal of the Idaho Academy of Science, Vol. 28, No. 1, June 1992.

Carr, W. J., and D. E. Trimble, 1963. “Geology of the American Falls Quadrangle Idaho,” *U. S. Geological Survey Bulletin* 1121-G, pp. 44 .

Chaney, R.L., et al., 1988. "Effects of Zinc Smelter Emissions on Farms and Gardens at Palmerton, PA," in: D.D. Hemphill, ed., Trace Substances in Environmental Health-XXII, A Symposium, Columbia, MO: University of Missouri Press, pp. 263-280.

Chase, R., 1994. Pocatello Greenhouse and Floral, Inc. Personal interview, July 6, 1994

Chester, 1993. Data package for Job No. 93I067, Report #93-167, October 6, 1993.

Chester, 1994a. “FMC Corporation Tap Hood Emissions Testing Furnace #4 Test Report,” Chester Environmental, January 18, 1994.

Chester 1994b. “FMC Corporation Tap Hood Emissions Testing Furnace #4 Analytical Report,” Chester Environmental, January 18, 1994.

Chester, 1994c. “FMC Corporation Determination of Emission Factors for Slag Handling Operations at FMC Plant Pocatello, Idaho Final Report,” Chester Environmental, January 19, 1994.

Christopherson, Dan, 1992. Personal communication between Jerry Gerald of Bechtel and D. Christopherson, Fort Hall Indian Reservation, Wildlife Division, September 28, 1992.

City of Chubbuck, 1992. Zoning District Maps. Chubbuck, Idaho.

City of Pocatello, 1981. Zoning District Map. Pocatello, Idaho.

City of Pocatello, 1989. "Assessment of Possible Effects of Pocatello's Treated Wastewater on the Biology and Chemistry of the Portneuf River." Final Report, November 1989.

City of Pocatello, 1992. Comprehensive Plan. Pocatello, Idaho.

Cochran, J.F., 1979. "Hundred-Fold Reduction in Permeability Proceedings, Under a Gypsum Stack," The Fertilizer Institute Environmental Symposium.

Code of Federal Regulations, 40 CFR Part 261.

Colvin, B., 1984. "Barn Owl Foraging Behavior and Secondary Poisoning Hazard from Rodenticide Use on Farms," Ph.D. Dissertation, Bowling Green State University, Bowling Green, OH, 296 pp.

Cook D.B., and W.J. Hamilton, 1944. "The Ecological Relationship of Red Fox Food in Eastern New York," Ecology Vol. 24, pp. 94-104.

Cooper, Phil, 1992. Personal communication between Kathleen Pahl of Bechtel and P. Cooper, Idaho Department of Fish and Game, October 19, 1992.

Core, John E., 1989. "Pacific Northwest Source Profile Library, Volumes I-IV," State of Oregon Department of Environmental Quality, Air Quality Division, Portland, Oregon, September 1989.

Cox, William M., 1988. "Protocol For Determining the Best Performing Model," U. S. EPA, Office of Air Quality Planning and Standards, Research Triangle Park, August 1988.

Craighead, J.J., and F.C. Craighead, 1956. Hawks, Owls and Wildlife. Harrisburg, PA: The Stackpole Co. and Washington, DC: Wildl. Manage. Inst.

CRC, 1980. <u>CRC Handbook of Chemistry and Physics</u>, 61st edition, CRC Press Inc., 1980.

Cronquist, Arthur, Arthur H. Holmgren, Noel H. Holmgren, and James L. Reveal, 1972. *Intermountain Flora.* Hafner Publishing Company, New York.

Cubbage, J. and S. Breidenbach, 1994. "Creation of Freshwater Sediment Quality Database and Preliminary Analysis of Freshwater Apparent Effects Thresholds," Department of Ecology. Olympia, Washington.

Dames & Moore, 1975. “Environmental Analysis Record, Proposed Land Exchange between U.S. Bureau of Land Management and the J.R. Simplot Company, Pocatello, Idaho, December, 1975.

Davis, A., M.V. Ruby and P.D. Bergstrom, 1992. "Bioavailability of Arsenic and Lead in Soils from the Butte, Montana, Mining District," Environ. Sci. Technol. Vol 26, No.3, pp. 461-468.

Desborough and Foord, 1992. "A Monoclinic, Psuedo-orthorhombic Au-Hg Mineral of Potential Economic significance in Pleistocene Snake River Alluvial Deposits of Southeastern Idaho," The Canadian Mineralogist Vol. , pp. 1033-1038.

Di Toro, D.M., J.D. Mahony, D.J. Hansen, et al., 1990. "Toxicity of cadmium in sediments: The role acid volatile sulfide," Environ. Toxicol. Chem. Vol. 9. pp. 1489-1504.

DOE, 1990. “EMF Procedures Manual,” (HASL-300), Environmental Measurements Laboratory, Department of Energy, New York, N.Y., November 1990.

DOE, 1991. “EML Surface Air Sampling Program, 1989 Data,” EML-541. U. S. Department of Energy, Environmental Measurement Laboratory, New York, N.Y., August 1991.

Dohrenwend, J. C., 1987. Basin and Range: in Graf, W. L. (ed), Geomorphic Systems of North America, Geological Society of America Centennial, Special Vol. 2, Ch. 9, pp. 303-342.

DOI, 1977. "Final Environmental Impact Statement: Development of Phosphate Resources in Southeastern Idaho," U.S. Department of the Interior, USGS, BLM, 1977.

Drury, J.S., et al., 1980. "Reviews of the Environmental Effects of Pollutants: IX. Fluoride," EPA-600/1-78-050, U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, OH, September, 440 pp.

Eadie, W.R., 1943. "Food of the Red Fox in Southern New Hampshire," J. Wildl. Manage. Vol. 7, pp. 74-77.

Eckerlin, R.H., et al., 1986. "Toxic Effects of Food-Borne Fluoride in Silver Foxes," Cornell Veterinarian, Vol. 76, pp. 395-402.

Edwards, A.L., 1968. Experimental Design in Psychological Research, 3rd edition. Holt, Rinehart, and Winston, Inc., New York.

E&E (Ecology & Environment, Inc.), 1988. "Site Inspection Report for FMC/Simplot Sites, Pocatello, Idaho," April 1988.

E&E (Ecology & Environment, Inc.), 1991. EPA Data Needs Document, June 1991.

E&E (Ecology and Environment), 1992. "Work Plan for Risk Assessment of EMF, Pocatello, ID," Seattle, Washington, August 1992.

E&E (Ecology and Environment), 1993. "EMF Site Ecological Risk Assessment: Problem Formulation," Seattle, Washington.

E&E (Ecology and Environment, Inc.), 1994. "Ecological Assessment Work Plan, Eastern Michaud Flats Site, Pocatello, Idaho", prepared for the U.S. Environmental Protection Agency, ARCS Region 10, Document Control No. ZP3060.37.1, Seattle, Washington, September 1994.

E&E (Ecology and Environment, Inc.), 1995. "Draft Baseline Human Health Risk Assessment, Eastern Michaud Flats, Pocatello, Idaho," prepared for U.S. Environmental Protection Agency, March 1995; revised July 1995.

Ecology Consultants, Inc., 1977. "Aquatic Survey of the Portneuf River near Pocatello, Idaho," Submitted to J.R. Simplot Company, Minerals and Chemical Division, September 1977.

Eisenbud, M, 1987. "Environmental Radioactivity from Natural, Industrial, and Military Sources," 3rd. ed., Academic Press, pp 147-150.

EQM and EHP Associates (Environmental Quality Management, Inc. and E.H. Pechan & Associates, Inc.), 1992. "Control Technology Evaluation of FMC Pocatello Elemental Phosphorus Manufacturing Plant," by Environmental Quality Management, Inc. and E.H. Pechan & Associates, Inc., August 1992.

EPA (U.S. Environmental Protection Agency), 1975. "Radioactivity Distribution in Phosphate Plants, By-products, Effluents, and Wastes, Technical Note," ORP/CSD-75-3, Office of Radiation Programs, Washington D.C., 1975.

EPA (U.S. Environmental Protection Agency), 1977a. "Final Guideline Document: Control of Fluoride Emissions from Existing Phosphate Fertilizer Plants," EPA Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-450/2-77, March 1977.

EPA (U.S. Environmental Protection Agency), 1977b. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II – Ambient Air Specifics Methods, EPA-600/4-77-027a, Office of Research and Development Environmental Monitoring Systems Laboratory, Research Triangle Park, NC, May 1977.

EPA (U.S. Environmental Protection Agency), 1978a. "Radiological Surveys of Idaho Ore Processing – The Wet Process Plant," Las Vegas, Technical Note, ORP/LV-78-1, April 1978.

EPA (U.S. Environmental Protection Agency), 1978b. "Radiological Surveys of Idaho Ore processing – The Thermal Process Plant," Las Vegas, Technical Note, ORP/LV-77-3, November 1977.

EPA (U.S. Environmental Protection Agency), 1979. "Handbook for Analytical Quality Control in Water and Wastewater Laboratories," Environmental Monitoring and Support Laboratory, Office of Research and Development, Cincinnati, Ohio, EPA-600/4-79-019, March 1979.

EPA (U.S. Environmental Protection Agency, 1980. "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, August 1980.

EPA (U.S. Environmental Protection Agency), 1983. "Methods for Chemical Analysis of Water and Wastes," EPA 600/4-79-020, revision, March 1983.

EPA (U.S. Environmental Protection Agency), 1984a. "NEIC Policies and Procedures," National Enforcement Investigations Center, Denver, Colorado, revised.

EPA (U.S. Environmental Protection Agency), 1984b. "Test Method for Evaluating Solid Waste," EPA-SW846, 3rd edition.

EPA (U.S. Environmental Protection Agency), 1984c. "Emissions of Lead^{210} and Polonium^{210} from Phosphate Rock Calciners at Elemental Phosphorus Plants: FMC Plant, Pocatello, Idaho," Office of Radiation Programs, Research Triangle Park, NC, June 1984.

EPA (U.S. Environmental Protection Agency), 1984d. "Radiochemistry Procedures Manual," Eastern Environmental Radiation Facility, Office of Radiation Programs, Montgomery, AL, EPA-520/5-84-006, June 1984.

EPA (U.S. Environmental Protection Agency), 1985. "Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources," AP-42, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 1985.

EPA (U.S. Environmental Protection Agency), 1986a "Guidelines on Air Quality Models (revised)," EPA-405/2-78-027R, Office of Air Quality Planning and Standards, Research Triangle Park, NC, July 1986.

EPA (U.S. Environmental Protection Agency), 1986b. "Compilation of Air Pollutant Emission Factors Volume I: Stationary Point and Area Sources – Supplement A," AP-42, Office of Air Quality Planning and Standards, Research Triangle Park, NC, October 1986.

EPA (U.S. Environmental Protection Agency), 1986c. "Test Methods for Evaluating Solid Waste (SW-846): Physical/chemical Methods," third edition, Office of Solid Waste, November 1986.

EPA (U.S. Environmental Protection Agency), 1987. "Ambient Monitoring Guidelines for Prevention of Significant Deterioration," Office of Air Quality Planning and Standards, Research Triangle Park, EP-450/48-87-007, May 1987.

EPA (U.S. Environmental Protection Agency), 1987. National Ambient Air Quality Standards (NAAQS), 40CFR Section 50.6, July 1, 1987.

EPA (U.S. Environmental Protection Agency), 1988a. "Superfund Exposure Assessment Manual," OSWER Directive No. 9285.5-1, April 1988.

EPA (U.S. Environmental Protection Agency), 1988b. "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses," July 1, 1988.

EPA (U.S. Environmental Protection Agency), 1988c. "Compilation of Air Pollutant Emission Factors Volume I: Stationary Point and Area Sources - Supplement B," AP-42, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 1988."

EPA (U.S. Environmental Protection Agency), 1988d. "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA."

EPA (U.S. Environmental Protection Agency), 1988e. "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses."

EPA (U.S. Environmental Protection Agency), 1989a. "Air/Superfund National Technical Guidance Study Series," Vol. 4, EPA-450/1-89-004, Office of Air Quality Planning and Standards, Research Triangle Park, NC, July 1989.

EPA (U.S. Environmental Protection Agency), 1989b. "Region 10 Groundwater Data Management," EPA Order No. R10 7500.a, August 1989.

EPA (U.S. Environmental Protection Agency), 1989c. "Environmental Impact Statement NESHAPS for Radionuclides," EPA/520/1-89-006-1, Office of Radiation Programs, Washington D.C., September 1989.

EPA (U.S. Environmental Protection Agency), 1989d. "Environmental Impact Statement for NESHAP's Radionuclides, Volume 2, Background Information Document (Risk Assessment)," Office of Radiation Programs, EPA 520/1-89-006-1, September 1989.

EPA (U.S. Environmental Protection Agency), 1989e. “Analysis of Storm Event Characteristics for Selected Rainfall Gauges Throughout the U.S,” prepared by Woodward-Clyde Consultants, November 1989.

EPA (U.S. Environmental Protection Agency), 1989f. “Rapid Bioassessment Protocols for Use in Streams and Rivers, Benthic Macroinvertebrates and Fish,” EPA/440/4-89/001.

EPA (U.S. Environmental Protection Agency, 1989g. “Risk Assessment Guidance for Superfund, Volume I: Human Health Assessment Manual (Part A)," EPA/540/1-89/002, Office of Emergency and Remedial Response, Washington, DC, December 1989.

EPA (U.S. Environmental Protection Agency), 1989h. “Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual (Interim Final), EPA/540/1-89/001, Office of Emergency and Remedial Response, Washington, DC, March 1989.

EPA (U.S. Environmental Protection Agency), 1989i. “Contract Laboratory Program, Statement of Work for Inorganics Analysis, Multimedia, Multi-concentration,” SOW No. 787, revised February, 1989.

EPA (U.S. Environmental Protection Agency), 1990a. "Air Emission Species Manual. Volume 2: Particulate Species," second edition, EPA-450/2-90-002a, Research Triangle Park, NC, January 1990.

EPA (U.S. Environmental Protection Agency), 1990b. "Air Emissions Species Manual, Vol. 1: Volatile Organic Compound Species," second edition., EPA-450/2-90-001a, Research Triangle Park, NC, January 1990.

EPA (U.S. Environmental Protection Agency), 1990c. "Supplement B to the Guideline on Air Quality Models (Revised)," Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 1990.

EPA (U.S. Environmental Protection Agency), 1990d. "Compilation of Air Pollutant Emission Factors Volume I: Stationary Point and Area Sources - Supplement C," AP-42, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 1990.

EPA (U.S. Environmental Protection Agency), 1990e. Revision to Section 2.1.1 of the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II – Ambient Air Specifics Methods, EPA-600/4-77-027a, Office of Research and Development Environmental Monitoring Systems Laboratory, Research Triangle Park, NC.

EPA (U.S. Environmental Protection Agency), 1990f. “Test Methods for Evaluating Solid Waste,” EPA SW-846, revision 1, November 1990.

EPA (U.S. Environmental Protection Agency), 1991a. “Administrative Order on Consent for Remedial Investigation/Feasibility Study for Eastern Michaud Flat Site,” U.S. EPA Docket No. 1090-01-06-104, signed May 30, 1991.

EPA (U.S. Environmental Protection Agency), 1991b. “Contract Laboratory Program Statement of Work Analysis of Ambient Air (AA),” Revision IAIR01.2, July 1991.

EPA (U.S. Environmental Protection Agency), 1991c. "Compilation of Air Pollutant Emission Factors Volume I: Stationary Point and Area Sources - Supplement D," AP-42, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September 1991.

EPA (U.S. Environmental Protection Agency), 1992a. "Potential Uses of Phosphogypsum and Associated Risks, Background Information Document," EPA 402-R-92-002, May 1992.

EPA (U.S. Environmental Protection Agency), 1992b. "Health Effects Assessment Summary Tables, Annual FY 1992," EPA OSWER, March 1992.

EPA (U.S. Environmental Protection Agency), 1992c. "PM_{10} Saturation Study for Pocatello, Idaho," Ambient Monitoring and Analysis Branch, April 1992.

EPA (U.S. Environmental Protection Agency), 1992d. "User's Guide for the Fugitive Dust Model (FDM) (revised) Volume I: User's Instructions," revised September 1992.

EPA (U.S. Environmental Protection Agency), 1992e. “Supplemental Guidance to RAGS: Calculating the Concentration Term,” Office of Solid Waste and Emergency Response, Washington, D.C., Intermittent Bulletin Volume 1, Number 1; Publication 9285.7-081, May 1992.

EPA (U.S. Environmental Protection Agency), 1992f. Personal communication between Robert Wilson of EPA and Tim Morgan of Bechtel Environmental, Inc.

EPA (U.S. Environmental Protection Agency), 1993a. “Region III Risk-based Concentration Table, January, 1993.” Prepared by Roy L. Smith, Ph.D., Senior Toxicologist, Technical Support Section, Philadelphia, Pennsylvania.

EPA (U.S. Environmental Protection Agency), 1993b. Letter from William Adams of U.S. Environmental Protection Agency, Region 10 to Ron Hosking of FMC Corporation and to Earl Mapes of J.R. Simplot. Attachment : EPA Proposed Ambient Air Screening Levels, July 2, 1993.

EPA (U.S. Environmental Protection Agency), 1993c. "Wildlife Exposure Factors Handbook," Vol. 1, EPA/600/R-93/187a, December 1993.

EPA (U.S. Environmental Protection Agency), 1994. "Health Effects Summary Tables. Prepared by the Office of Health and Environmental Assessment, Environmental Assessment and Criteria Office, Cincinnati, Ohio, for the Office of Solid Waste and Emergency Response, Office of Emergency and Remedial Response, Washington, D.C., March 1994.

EPA (U.S. Environmental Protection Agency), 1994a. Transmittal letter between Bill Adams of the EPA and Messrs. Steve Curreri of J.R. Simplot and Jim Sieverson of FMC Corporation, November 13, 1994.

EPA (U.S. Environmental Protection Agency), 1994b. Personal communication between Robert Wilson of EPA Region 10 and Tim Morgan of Bechtel Environmental, Inc., August 11, 1994.

EPA (U.S. Environmental Protection Agency), 1995a. Region III Risk-based Concentration Table, January through June 1995. Prepared by Roy L. Smith, Ph.D., Senior Toxicologist, Technical Support Section, Philadelphia, Pennsylvania, March 7, 1995.

EPA (U.S. Environmental Protection Agency), 1995b. Transmittal letter between Bill Adams of the EPA and Messrs. Steve Curreri of J.R. Simplot and Jim Sieverson of FMC Corporation, January 9, 1995.

Federal Register, Volume 55, No. 169, pp. 35502-35525, August 30, 1990.

Feldberg, Lori, 1993. Personal communication between Larry McDonough of Bechtel Environmental, Inc., and Lori Feldberg of the Bannock County Planning Department, January 4, 1993.

Fenwick, Gary, 1993a. Personal communication between William Myers of Bechtel Environmental, Inc., and Gary Fenwick, Shoshone-Bannock tribal council representative, September 15, 1993.

Fenwick, G., 1993b. Personal communication between Kathleen Pahl of Bechtel Environmental, Inc., and Gary Fenwick, Shoshone-Bannock tribal council representative, January 18, 1993.

Fingerle, H., G. Fischer, and H.G. Classen, 1982. "Failure to Produce Hypertension in Rats by Chronic exposure to cadmium," Food Chem. Toxicol., Vol. 20, pp. 301-306.

Fitch, H.S., F. Swenson, and D.F. Tillotson, 1946. "Behavior and Food Habits of the Red-tailed Hawk," Condor Vol. 48, pp. 205-237.

Foth, H. D., and L. M. Turk, 1972. <u>Fundamentals of Soil Science</u>, 5th ed. John Wiley and Sons, Inc., New York.

FMC and Simplot, 1993. “Response to EPA Comments on Phase II Site Investigation Plan,” by FMC and Simplot, August 9, 1993.

FMC (FMC Corporation), 1976-1990. Internal Vegetative Fluoride Analysis Reports from 1976 to 1990, FMC Corporation.

FMC (FMC Corporation), 1991a. “RCRA Part B Permit Application, FMC Corporation Elemental Phosphorus Manufacturing Plant, Pocatello, ID,” March 1991.

FMC (FMC Corporation), 1991b. “FMC Facility Assessment,” Pocatello, Idaho, June 1991.

FMC (FMC Corporation), 1993. “RCRA Interim Status Groundwater Monitoring Assessment, August 1993.”

FMC (FMC Corporation), 1994. “RCRA Interim Status 1993 Groundwater Monitoring Assessment, February 1994.”

FMC (FMC Corporation), 1995a. Personal communication between Lew Hammermeister of FMC Corporation and Tim Morgan of Bechtel Environmental, Inc.

FMC (FMC Corporation), 1995b. “RCRA Interim Status 1994 Groundwater Monitoring Assessment, February 1995.”

FMC (FMC Corporation), 1995c. “Pocatello Material Balance,” FMC Pocatello Phosphorus Plant, March 1995.

FMC (FMC Corporation), 1996 “RCRA Interim Status 1995 Groundwater Monitoring Assessment,” by FMC Corporation, Phosphorus Chemical Division, Pocatello, Idaho, February 1996.

Freeze, R. A., and J. A. Cherry, 1979. <u>Groundwater,</u> Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Galloway, W.E., and D.K. Hobday, 1983. <u>Terrigenous Clastic Depositional Systems</u>. Application to Petroleum, Coal, and Uranium Exploration, New York, NY, Springer, Verlag.

Gardener, G. 1994. Bannock County Extension Agent. Telephone interview, July 14, 1994.

Gates, J.M., 1972. "Red-tailed Hawk Populations and Ecology in East-central Wisconsin," Wilson Bull. Vol. 84, pp. 421-433.

Geraghty and Miller, Inc., 1982a. “Ground-Water Data from the FMC Plant Vicinity, Pocatello, Idaho,” July 1982.

Geraghty and Miller, Inc., 1982b. “Hydrogeologic Conditions in the Vicinity of the FMC Plant, Pocatello, Idaho,” November 1982.

Gilbert, R.O., 1987. Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York, New York, 1987.

Goldstein, F.J., 1981. “Hydrogeology and Water Quality of Michaud Flats, Southeastern Idaho,” Idaho State University thesis.

Green, J.S., and J.T. Flinders, 1981. "Diets of Sympatric Red Foxes and Coyotes in Southeastern Idaho," Geat Basin Nat. Vol. 41, pp. 251-254.

Groves, Craig R., and J. S. Marks, 1985. “Annotated Checklist of Idaho Vertebrates,” *TEBIWA*, Vol. 22, pp. 10-26, December 1985.

Gubayni, J.A., R.M. Case and G. Winfield. 1992. "Diet and Nesting Success of Barn Owls Breeding in Western Nebraska", The American Midland Naturalist, Volume 127, Number 2, pp. 224-232.

Hamilton, K.L., 1978a. "Mule Deer Population Ecology, Habitat Relationships, and Relations to Livestock Grazing Management and Elk in the Missouri River Breaks, Montana," in: "Montana Deer Studies," Prog. Rep., Fed. Aid in Wildl. Restor., Proj. W-120-R-9, Montana Dept. Fish Game, Helena. pp. 141-183.

Hamilton, K.L., 1978b. "Population Ecology and Habitat Relationships of Mule Deer and White-tailed Deer in the Prairie-agricultural Habitats of Eastern Montana. in: "Montana Deer Studies," Prog. Rep., Fed. Aid in Wildl. Restor., Proj. W-120-R-9, Montana Dept. Fish Game, Helena. pp. 185-197.

Harrison, Ted, 1989. WVSCORE documentation, June 17, 1989.

Henny, C. J., and P. M. Burke, 1990. “Fluoride Accumulation and Bone Strength in Wild Black-crowned Night Herons,” *Arch. Environ. Contam. Toxicol.* Vol. 19, pp. 132-137.

Hoffman, D.J., et al., 1985. "Effects of Fluoride on Screech Owl Reproduction: Teratological Evaluation, Growth, and Blood Chemistry in Hatchlings," Toxicology Letters, Vol. 26, pp. 19-24.

Hogander, Geoff, 1992. Personal communication between Kathleen Pahl of Bechtel Environmental, Inc., and Geoff Hogander of the Bureau of Land Management, September 15, 1992.

Holmes, C. D. 1985. "Typical Analysis: Summary Table for Slag, Ferrophos and Precipitator Dust," FMC, July 1985.

Holte, C., 1993. Idaho State University. Personal communication.

Howard, Richard P., 1992a. “Assessment of Bald Eagle Use in the American Falls Project Area Snake River, Idaho,” prepared for the Bureau of Reclamation, Regional Office, Boise, Idaho by the U.S. Fish and Wildlife Service, Boise Field Office, Boise, Idaho.

Howard, Richard P., 1992b. Personal communication between Kathleen Pahl of Bechtel Environmental, Inc., and Richard Howard of the U.S. Fish and Wildlife Service, Boise Field Office, Boise, Idaho, October 26, 1992.

Houser, B. B., 1992. Quaternary stratigraphy of an area northeast of American Falls Reservoir, eastern Snake River Plan, Idaho, Link, P. K., et al., eds., Regional Geology of Eastern Idaho and Western Wyoming, *Geological Society of America Memoir*, Vol. 179, pp. 269-288.

Idaho Conservation Data Center, 1992. Letter to Kathleen Pahl of Bechtel Environmental, Inc., regarding rare, threatened, and endangered species occurring in the EMF area, Boise, Idaho.

Idaho Department of Fish and Game, 1981-1991. In cooperation with U.S. Fish and Wildlife Service. Data Files. U.S. Fish and Wildlife, Winter Waterfowl Survey, Pacific Flyway, January 7-11, 1991; January 2-5, 1990; January 3-6, 1989; January 4-8, 1988; January 5-9, 1987; January 6-10, 1986; January 1-7, 1984; January 2-8, 1983; January 4-8, 1982; January 5-9, 1981.

Idaho Department of Fish and Game, 1990-1991. Unpublished data files for 1990 and 1991, Boise, Idaho. Midwinter Bald Eagle Counts at American Falls Reservoir.

Idaho Department of Health and Welfare, 1989. Open Files.

Idaho Department of Water Resources, 1989. “Rules and Regulations: Well Construction Standards,” Boise, Idaho, January 1989.

Idaho Department of Water Resources, 1992. Data Files. Groundwater Wells Registered with Idaho Department of Water Resources as of 1992, Ownership, Location, and Total Capacity.

IDEQ (Idaho Department of Environmental Quality), 1992. Draft State Implementation Plant Emission Inventory for PM_{10}, various computer spreadsheets dated, July, August, and October 1992.

IDEQ (Idaho Department of Environmental Quality), 1994. Letter dated February 25, 1994, on nephelometer data from the Gould street monitoring station in Pocatello, includes annotation by IDEQ written December 1994

IDEQ (Idaho Department of Environmental Quality), 1994. Personal communication by FAX between Gordon Brown of IDEQ and Art Day of Bechtel Environmental, Inc., December 15, 1995

INEL (Idaho National Engineering Laboratory), 1995. “Managing Soil Moisture on Waste Burial Sites,” by Jay E. Anderson, Robert S. Nowak, Teresa D. Ratzlaff, and O. Doyle Markham, U.S. Department of Energy, Idaho Field Office, November 1991.

Ingles, L.G., 1965. Mammals of the Pacific States, Stanford University Press, Stanford, California.

Jacobson, N.D., 1982. “Ground-Water Conditions in the Eastern Part of Michaud Flats, Fort Hall Indian Reservation, Idaho,” U.S. Geological Survey Open-File Report 82-570, Boise, Idaho, June 1982.

Jacobson, N.D., 1984. “Hydrogeology of Eastern Michaud Flats, Fort Hall Indian Reservation, Idaho,” U.S. Geological Survey Open-File Report 84-4201, Boise, Idaho.

Jacobson, N.D., 1989. “Water-Quality Data for Selected Sites on Michaud Flats, Fort Hall Indian Reservation, Idaho, December 1982 to July 1987,” U.S. Geological Survey Open-File Report 89-71, Boise, Idaho.

Janes, S.W., 1984. "Influences of Territory Composition and Interspecific Competition on Red-tailed Hawk Reproductive Success," Ecology Vol. 65, pp. 862-870.

Janssen, P.J., J.A. Janus, and A.G. Knaap, 1989. "Integrated Criteria Document Fluorides: Effects," (Appendix), Bilthoven, the Netherlands: National Institute of Public Health and Environmental Protection, Appendix to Report Number 758474010, September, 98 pp.

John, H.L., B.L. McNeal, G.A. O'Connor, 1985. Soil Chemistry. John Wiley and Sons, Inc., New York.

Johnson and Finlayson, 1989. “Artificial Recharge of Ground Water,” Proceedings of the International Symposium sponsored by the Irrigation and Drainage Division of the American Society of Civil Engineers and the Los Angeles Section of ASCE at Anaheim, California during August 23–27, 1988; the American Society of Civil Engineers, New York, edited by A.I. Johnson and Donald J. Finlayson, 1989.

Johnson, D. W., J. C. Kent, and D. K. Campbell, 1977. “Availability and Concentration of Pollutants from American Falls Reservoir Sediments to Forage and Predaceous Fishes,” Idaho Water Resources Research Institute, Moscow, Idaho.

Kabata-Pendis, A. and H. Pendias, 1992. Trace elements in soils and plants. CRC Press, Roca Raton.

Kay, C.E., et al., 1975. "Industrial Fluorosis in Wild Mule and Whitetail Deer from Western Montana," Fluoride, Vol. 8, No. 4, pp. 182-190.

Keller, Barry, 1992. Personal communication between Kathleen Pahl of Bechtel Environmental, Inc., and Dr. Barry Keller, Curator of Mammals, Idaho National History Museum, Idaho State University, September 15, 1992.

Kellogg, K.S., 1992. “Cretaceous thrusting and Neogene block rotation in the northern Portneuf Range region, southeastern Idaho; in Link, P.K., et al., eds., Regional Geology of Eastern Idaho and Western Wyoming,” *Geological Society of America Memoir*, Vol.179, pp. 95-113.

Korschgen, L.J., 1959. Food Habits of the Red Fox (Vulpes vulpes) in Missouri. J Wildl. Manage. Vol. 23, pp. 168-176.

Larsen, R. I., PhD, 1971. “A Mathematical Model for Relating Air Quality Measurements to Air Quality Standards,” U.S. Environmental Protection Agency Office of Air Programs, Research Triangle Park, North Carolina, November 1971.

Lindsay, W.L., 1979. Chemical Equilibria in Soils. John Wiley and Sons, Inc., New York.

Lombardo, N. 1985. "Recovery Values from Elemental Phosphorus Production Wastes," Letter Report from Hazen Research, Inc., to FMC Corporation, September 6, 1985.

Low, M., 1993. Telephone conversation between Larry Adams of Bechtel Environmental, Inc., and Mark Low of the Idaho Department of Health, Southeast District, December 10, 1993.

Low, Walton H. and William H. Mullins, 1990. “Reconnaissance Investigation of Water Quality, Bottom Sediment, and Biota Associated With Irrigation Drainage In The American Falls Reservoir Area, Idaho, 1988-89,” U.S. Geological Survey Water Resources Investigations Report 90-4120. Boise, Idaho.

Ludlum, J. C., 1942. “Pre-Cambrian Formations at Pocatello, Idaho,” *Journal of Geology*, Vol. 50, pp. 85-95.

Ludlum, J. C., 1943. “Structure and Stratigraphy of Part of the Bannock Range, Idaho,” *Geological Society of America Bulletin*, Vol. 54, pp. 973-986.

MacDonald, D.W., 1980. "Social Factors Affecting Reproduction Amongst Red Foxes (Vulpes vulpes L. 1758)," in: Zimen, E., ed. The Red Fox, Bioggeographica: v. 18. W. Junk, The Hague, Netherlands; pp. 123-175.

MacGregor, A.E., 1942. "Late Fall and Winter Foods of Foxes in Central Massachusetts," J. Wildl. Manage. Vol. 6, pp. 221-224.

Mackie, R.J., K.L. Hamlin and D.F. Pac, 1982. "Mule Deer (Odocoileus hemionus)," in: Chapman, J.A. and G.A. Feldhamer. Wild mammals of North America. The Johns Hopkins University Press,. pp. 862-877.

MacLaren, P.A., S.H. Anderson, D.E. Rude, 1988. "Food Habits and Nest Characteristics of Breeding Raptors in Southwestern Wyoming," Great Basin Nat. Vol. 48, pp. 548-553.

Mader, W.J., 1978. A Comparative Nesting Study of Nesting Red-tailed Hawks and Harris' Hawks in Southern Arizona. Auk Vol. 95, pp. 327-337.

Malde, H. E., 1968. “The Catastrophic Late Pleistocene Bonneville Flood in the Snake River Plain, Idaho,” U. S. Geological Survey Professional Paper, Vol. 596, pp. 51.

Marquardt, Gary, 1992. Personal communication between Jerry W. Gerald of Bechtel Environmental, Inc., and Gary Marquardt, Aqua Sea Inc. plant manager, December 22, 1992.

Mazanowski, William, 1992. “Quantitation of Heavy Metals Associated with the Clay-silt Fraction of Sediment from the Portneuf and Blackfoot Rivers in Southeast Idaho,” Idaho State University, Chemistry Department, Independent Research.

McSorley, M. R., 1976. Letter to J. Eyre of SICOG with water quality data on the Portneuf River.

Mende, Jim, 1992. Personal communication between Jerry W. Gerald of Bechtel Environmental, Inc., and Jim Mende of the Idaho Department of Fish and Game, December 29, 1992.

Miller, G.W., 1986. “Levels of Fluoride in Vegetation Samples Collected from the Soda Springs and Pocatello Areas During the 1986 Growing Season,” Utah State University Foundation, December 1986. Idaho Air Quality Bureau, 450 West State Street, Boise, Idaho.

Miller, G.W., 1987. “Levels of Fluoride in Vegetation Samples Collected from the Soda Springs and Pocatello Areas During the 1987 Growing Season,” Utah State University Foundation, December 1987. Report for the Idaho Department of Health and Welfare – Division of the Environment Air Quality Bureau, 450 West State Street, Boise, Idaho.

Miller, G.W., 1990. "Levels of Fluoride in Vegetation Samples Collected from Pocatello Areas During the 1990 Growing Season," prepared for J.R. Simplot Company, December 1990.

Minshall, G. W., and D. A. Andrews, 1973. “An Ecological Investigation of the Portneuf River, Idaho; a Semiarid-Land Stream Subjected to Pollution,” *Freshwater Biology*, Vol. 3, pp. 1-30, Idaho State University, Pocatello, Idaho.

Mohr, R. E., 1968. “Survey of the Fishes of the Portneuf River and Its Tributaries,” unpublished M.Sc. thesis, Idaho State University, Pocatello, Idaho.

Morrison-Knudsen, 1989. Eastern Michaud Flats Contamination Site Study,” prepared for J. R. Simplot Company, June 1989.

Moseley, R. and C. Groves, 1992. “Rare, Threatened and Endangered Plants and Animals of Idaho,” Natural Heritage Section, Nongame and Endangered Wildlife Program, Idaho Department of Fish and Game.

Newell, G.W. and H.J. Schmidt, 1958. "The Effects of Feeding Fluorine, as Sodium, to Dairy Cattle- A Six-Year Study," American Journal of Veterinary Research, April, pp. 363-376.

Newman, J.R. and J.J. Murphy, 1979. "Effects of Industrial Fluoride on Black-Tailed Deer (Preliminary Report)," Fluoride, Vol. 12, No. 3, pp. 129-135.

Newman, J.R. and D. Markey, 1976. "Effects of Elevated Levels of Fluoride on Deer Mice (Peromyscus maniculatus)," Fluoride, Volume 9(1), pp. 47-53.

NOAA (National Oceanic and Atmospheric Administration), 1973. Atlas 2, Vol. V.

NOAA (National Oceanic and Atmospheric Administration), 1982. “Mean Monthly, Seasonal, and Annual Pan Evaporation for the United States,” Technical Report, NWS 34, December 1982.

NOAA (National Oceanic and Atmospheric Administration), 1989. “Local Climatological Data (LCD) Summary with Comparative Data for Pocatello, Idaho.”

NOAA (National Oceanic and Atmospheric Administration), 1991. “Local Climatological Data, Annual Summary with Comparative Data, Pocatello, Idaho.”

NOAA (National Oceanic and Atmospheric Administration), 1994. “Local Climatological Data (LCD) Summary with Comparative Data for Pocatello, Idaho.”

Nordberg, G.F., 1992. "Cadmium, Metallothionein, and Renal Tubular Toxicity," in: Nordberg, G.F., et al., "Cadmium in the Human Environment: Toxicity and Carcinogenicity," Lyon, France: International Agency for Research on Cancer, Publication Number 118, pp. 293-297.

Nriagu, J.O. and Davidson, I. D., 1986. Toxic Metals in the Atmosphere, published by John Wiley & Sons, Vol. 17 in the Wiley Series in Advances in Environmental Science and Technology, January 1986.

OMNI Environmental Services, Inc., 1992. "Emission Inventory for PM10 in Pocatello, Idaho Volume I," March 6, 1992.

Park, Richard A., 1974. “A Multivariate Analytical Strategy for Classifying Paleoenvironments,” *Mathematical Geology*, Volume 6, No. 4, 1974, Plenum Publishing Corporation.

Pattee, O.H., et al., 1988. "Effects of Dietary Fluoride on Reproduction in Eastern Screech-Owl," Archives of Environmental Contamination and Toxicology, Vol. 17, pp. 213-218.

PEI, 1985. “Evaluation of Waste Management for Phosphate Processing,” consulting report prepared for U.S. EPA by PEI Associates, Inc., Cincinnati, Ohio, April 1985.

PEI Associates, Inc., 1986. "Inspection Report FMC Corporation, Pocatello, Idaho," Draft, October 1986.

Perry, James A., 1977. “Water Quality Status Report, Lower Portneuf River,” Idaho Department of Health and Welfare, Report No. WQ-22, Final Report.

Perry, J. A., W. H. Clark, and O. J. Smith Museum of National History, 1990. “Groundwater Classification through Spring Chemistry: The Lower Portneuf River, Southeastern Idaho,” *Journal of the Idaho Academy of Science,* Vol. 26, No 1/2, June/December 1990.

Persaud, D., R. Jaagumagi and A. Hayton, 1993. "Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario," Ontario Ministry of Environment and Energy. Queen's Printer for Ontario.

Peterson, J. A., 1988, “Eastern Great Basin and Snake River Downwarp, Geology and Petroleum Resources,” U. S. Geological Survey Open-File Report 88-450-H, pp. 54.

Pierce, K. L., and L. A. Morgan, 1992. “The Track of the Yellowstone Hot Spot: Volcanism, Faulting and Uplift,” in Link, P.K., et al. eds., Regional Geology of Eastern Idaho and Western Wyoming, *Geological Society of America Memoir*, Vol. 179, pp. 1-53.

Piper, A.M., 1944. “A Graphic Procedure in the Geochemical Interpretation of Water Analysis,” Transactions, American Geophysical Union, Vol. 25, pp. 914-923.

Platts, W. S., W. F. Meghan, and G. W. Minshall, 1983. “Methods for Evaluating Stream, Riparian, and Biotic Conditions,” General Technical Report INT-138. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station.

Preston, C.R., 1990. "Distribution of Raptor Foraging in Relation to Prey Biomass and Habitat Structure," Condor Vol. 92, pp. 197-112.

RAGS, 1991. "Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A)," EPA/540/1-89/002. Office of Emergency and Remedial Responce, U.S. EPA, Washington, DC.

Radian Corporation, 1984. "Emission Testing: Phosphate Rock Calciners at J. R. Simplot Facility - Pocatello, Idaho, Emission Test Report," Radian Corporation, Research Triangle Park, NC, DCN# 84-231-054-16-03, February 1984.

Renn, Frank, 1992. Personal communication between Kathleen Pahl of Bechtel Environmental, Inc., and Frank Renn, Raptor Rehabilitation Specialist, Idaho Department of Fish and Game, September 17, 1992.

Richardson, M.E., M.R.S. Fox, and B.E. Fry, 1974. "Pathological Changes Produced in Japanese Quail by Ingestion of Cadmium," Journal of Nutrition, Vol. 104, pp. 323-338.

Rogers, K.J., P.F. Ffolliot and D.R. Patton, 1978. "Home Range and Movement of Five Mule Deer in a Semidesert Grass-shrub Community," U.S.D.A. For. Serv. Res. Pap. RM-355. 6pp.

Rosenburg, C.P., 1986. "Barn Owl Habitat and Prey Use in Agricultural Eastern Virginia," M.Sc. Thesis, College of William and Mary, Williamsburg, VA.

Ruby, M.V., A. Davis, T.E. Link., et al., 1993. "Development of an In Vitro Screening Test to Evaluate the In Vivo Bioaccessibility of Ingested Mine-waste Lead," Environ. Sci. Technol. Vol. 27. pp. 2870-7.

Ryan, B., 1992. Personal communication between Bill Ryan of the EPA and Tim Morgan of Bechtel Environmental, Inc., October 1992.

Ruffner, J. A., 1978. *Climates of the States*, Vol. I, Gale Research Company, Detroit, MI.

Sadiq, M., T.H. Zaidi and A.A. Mian, 1981. "Environmental Behavior of Arsenic in Soils: Theoretical," Water, Air and Soil Pollution. Vol. 20. pp. 369-377.

Samuel, D.E. and B.B. Nelson, 1982. "Foxes," in: Chapman, J.A.; G.A. Feldhammer., eds. Wild mammals of North America. Baltimore, MD: Johns Hopkins University Pres: pp. 475-490.

Sargeant, A.B., 1972. "Red Fox Spatial Characteristics in Relation to Waterfowl Predation," J. Wildl. Manage. Vol 36, pp. 225-236.

Sargeant, A.B. 1978. "Red Fox Prey Demands and Implication to Prairie Duck Production," J. Wildl. Manage. Vol. 42, pp. 520-27.

Sather, J. Henry, and R. Daniel Smith, 1984. An overview of major wetland functions and values, for Western Energy and Land Use Team by the U.S. Fish and Wildlife Service, FWS/OBS-84/18, Washington, D.C.

Schwartz, P.A., and Domenico, F.W., 1990. Physical and Chemical Hydrogeology, John Wiley and Sons, Inc.

Scott, W. E., et al., 1982. "Revised Quaternary Stratigraphy and Chronology in the American Falls area, southeastern Idaho," Idaho Bureau Mines and Geology Bulletin 26, pp. 581-595.

SCS (U.S. Soil Conservation Service), 1977. "Soil Survey of Fort Hall Area, Idaho, Parts of Bannock, Bingham, Caribou, and Power Counties," U.S. Soil Conservation Service, U.S. Department of Agriculture,
March 1977.

SCS (U.S. Soil Conservation Service), 1987a. "Soil Survey of Bannock County Area, Idaho, Parts of Bannock and Power Counties," U.S. Soil Conservation Service, U.S. Department of Agriculture, September 1987.

SCS (U.S. Soil Conservation Service), 1987b. Soil Survey of Bannock County, Idaho, and Soil Survey of Fort Hall Area, Idaho.

Seel, D.C. and A.G. Thompson, 1984. "Bone Fluoride in Predatory Birds in the British Isles," Environmental Pollution (Series A), Vol. 36, pp. 367-374.

Severson, R.C., and L.P. Gough, 1979. *Environmental Implications of Element Emissions from Phosphate-Processing Operations in Southeastern Idaho*, Geological Survey Professional Paper 1083.

Shoshone-Bannock Tribe, Fort Hall Indian Reservation, Wildlife Division, 1992. Data files. Wildlife species occurring on the Fort Hall Indian Reservation, Fort Hall, Idaho; Waterfowl Harvest 1981-1990 and Pheasant Harvest 1988-1990.

Shupe, J.L., et al., 1963. "The Effect of Fluorine on Dairy Cattle", II. "Clinical and Pathologic Effects," American Journal of Veterinary Research, Vol. 24, pp. 964-979.

Shupe, J.L., et al., 1984. "Fluoride Toxicity in Wild Ungulates," Journal of the American Veterinary Medical Association, Vol. 185, No. 11, pp. 1295-1300.

Shupe, J.L., et al., 1987. "Effects of Diets Containing Sodium Fluoride on Mink," Journal of Wildlife Diseases, Vol. 23, No. 4, pp. 606-613.

Shupe, J.L., et al., 1992. "The Pathology of Chronic Bovine Fluorosis: A Review," Toxicological Pathology, Vol. 20, No. 2, 274-285.

Sigler, W. F., and J. W. Sigler, 1987. *Fishes of the Great Basin, a Natural History*, University of Nevada Press, Reno, Nevada.

SII (Sciences International Inc.), 1994. Determination of the Need to Proceed with Phase II of River Delta Study (Flow Chart). November.

Simplot, 1990. Simplot Corporation, “Levels of Fluoride in Vegetation Samples Collected from Pocatello Areas During the 1990 Growing Season,” J. R. Simplot, December 1990.

Smart, Steve, 1992. Personal communication between Larry McDonough of Bechtel Environmental, Inc., and Steve Smart, Director of Public Works, Chubbuck, Idaho, November 1992.

Smith, C.R. and M.E. Richmond, 1972. "Factors Influencing Pellet Egestion and Gastric pH in the Barn Owl," Wilson Bull. Vol. 84, pp. 179-186.

Sposito, G., 1981. The Thermodynamics of Soil Solution. Clarendon Press, Oxford, U.K.

Spotte, S.H., 1970. <u>Fish and Invertebrate Culture</u>, John Wiley and Sons, New York, New York.

State of Idaho and Others, 1965 - 1992. Open Files.

State of Idaho, 1994. “Rules for the Control of Air Pollution in Idaho,” Department of Health and Welfare, Boise, Idaho.

Stearns H.T., Crandall, Lynn, and Steward, W.G., 1983. “Geology and Groundwater in the Michaud Flats Project, Power County, Idaho,” U.S. Geological Survey Water Supply Paper, Vol. 774, pp 268.

Stephens, George, 1992. Letter to Kathleen Pahl of Bechtel Environmental, Inc., from George Stephens, Information Manager for Idaho Conservation Data Center, Idaho Department of Fish and Game, October 26, 1992.

Stickel, L.F., 1968. "Home Range and Travels," in: J.A. King, ed., Biology of Peromyscus (Rodentia). The American Society of Mammalogists. pp. 373-410.

Stiff, H.A., 1951. “The Interpretation of Chemical Water Analyses by Means of Patterns,” *Journal of Petroleum Technology*, Vol. 3, No. 10, Section 1,2,3.

Swanson, R. W., V. E. McKelvey, and R. P. Sheldon, 1953. “Progress Report on Investigations of Western Phosphate Deposits,” prepared for the U.S. Geological Survey, Washington, D.C.

Suttie, J.W. et al., 1985. "Effects of Fluoride Ingestion on White-tailed Deer (Odocileus virginianus)", Journal of Wildlife Diseases, Vol. 21, No. 3, pp. 283-288.

TACB, 1988. "Air Quality Modeling Procedures," Texas Air Control Board, October 1988.

Talmadge, S.S. and B.T. Walton, 1990. "Comparative Evaluation of Several Small Animal Species as Monitors of Heavy Metals, Radionuclides, and Selected Organic Compounds in the Environment," Government Reports Announcements and Index, Issue 10, NTIS/DE91005647.

Taylor, I., 1994. Barn Owls: Predator-prey Relationships and Conservation. Cambridge University Press. 304 pp.

Taylor, W.P., 1956. The Deer of North America. Stackpole Company. Harrisburg, PA and The Wildlife Management Institute.

Terres, J.K., 1991. The Audubon Society Encyclopedia of North American Birds. Wings Books, New York.

Thomas, T.R. and L.R. Irby, 1991. "Winter Habitat Use by Mule Deer with Access to Wheat Fields and Planted Forb-grassland," Wildlife Society Bulletin, Vol. 19, pp. 155-162.

Thompson, Arnell, 1993. Personal communication between Jerry W. Gerald of Bechtel Environmental, Inc., and A. Thompson, commercial fisherman, January 5, 1993.

Thomson, A.G., 1987. "Fluoride in the Prey of Barn Owls," Environmental Pollution, Vol. 44, pp. 177-192.

TRC (TRC Environmental Corporation), 1993. “Pocatello PM_{10} SIP Dispersion Modeling Study,” for the Idaho Department of Environmental Quality,” March 8, 1993.

Trimble, D. E., and W. J. Carr, 1961. “The Michaud Delta and Bonneville River near Pocatello, Idaho,” *Geological Survey Research 1961*, U. S. Geological Survey Professional Paper 424-B, Article 69, pp. B-164 through B-166.

Trimble, D. E., 1976. “Geology of the Michaud and Pocatello Quadrangles, Bannock and Power Counties, Idaho,” *U. S. Geological Survey Bulletin*, Vol. 1400, pp. 88.

Trost, Dr. Charles, 1992. Personal communication between Kathleen Pahl of Bechtel Environmental, Inc., and C. Trost, Idaho State University, Department of Biology, September 14, 1992.

Turner, D. B., Workbook of Atmospheric Dispersion Estimates, Office of Air Programs, U.S. Environmental Protection Agency, Publication No. AP-26, Revised 1970.

UEC (United Engineers and Constructors, Inc.), 1992. “The Integrated Gaussian Model User's Guide,” Philadelphia, Pennsylvania.

UEC (United Engineers and Constructors, Inc.), 1993. Letter from EPA to UEC declaring that IGM has demonstrated equivalency to ISCST2, COMPLEX I, SHORTZ and RTDM and stating that IGM properly implements EPA's intermediate terrain policy, 1993.

U.S. Army Corps of Engineers, 1990. HEC-1 Users Manual, September 1990.

U.S. Bureau of Land Management, 1984. Surface Management Status, 42122-EI-TM-100, Pocatello, Idaho.

U.S. Department of Commerce, Bureau of Census, 1991. “Selected Population and Housing Characteristics: 1990 Pocatello City, Idaho,” Chubbuck City, Idaho, 1990.

U.S. Department of the Interior, 1979. "Snake River Birds of Prey Special Research Report," Boise, ID: Bureau of Land Management.

U.S. Department of the Interior, Bureau of Reclamation, 1992. “American Falls Resource Management Plan,” September 1992. Maps, wintering bald eagles; waterfowl use areas, wildlife use areas; trumpeter swan sightings, and use areas. Denver, Colorado.

U.S. FWS (U.S. Fish and Wildlife Service), 1980. Wetland Inventory Maps, Pocatello North and Pocatello South, Schiller, Michaud Creek, and Michaud, Idaho, Quadrangles. Denver, Colorado.

USGS (U.S. Geological Survey), 1935. “Water Utilization in the Snake River Basin,” by W.G. Hoyt, Water Supply Paper #657, Washington.

USGS (U.S. Geological Survey), 1962. Topographic Map, 1-to-250,000 Scale, Idaho Falls.

USGS (U.S. Geological Survey), 1970. “Fluvial Sediment Concepts,” Book 3, Chapter C1 (modified from Culbertson, Young, and Brice, 1967).

USGS (U.S. Geological Survey), 1971. Topographic Map, Pocatello North, Idaho: 7.5 minute topographic quadrangle.

USGS (U.S. Geological Survey), 1971/74. Map of Michaud, Idaho: 7.5 minute topographic quadrangle, 1:24,000, No.42112-H5-TF-024.

USGS (U.S. Geological Survey), 1977. “Development of Phosphate Resources in Southeastern Idaho: Final Environmental Impact Statement”.

USGS (U.S. Geological Survey), 1984. Map of Pocatello, Idaho: 1 degree metric topographic quadrangle 1:100,000, 42112-E1-TM-100.

Voigt, D.R. and D.W. MacDonald, 1984. "Variation in the Spatial and Social Behavior of the Red Fox, Vulpes vulpes," Acta. Zool. Fen. Vol. 171, pp. 261-265.

Voigt, D., 1987. "Red fox," in: Novak, M., J.A. Baker, M.E. Obbarel, et al., eds. Wild Fur Bearers Management and Conservation. University of Pittsburgh Press, Pittsburgh, PA, pp. 379-392.

Wackenhut, Martha, 1992. Personal communication between Kathleen Pahl of Bechtel Environmental, Inc., and M. Wackenhut, Idaho Department of Fish and Game, October 26, 1992.

Walker and Associates, 1992a. Site topographic maps, June 21, 1992.

Walker and Associates, 1992b. Aerial photograph, 1 inch = 725 feet, taken by Walker and Associates, Inc., June 1992.

Wallmo, O.C., 1981. "Mule and Black-tailed Deer Distribution and Habitats," in: O.C. Wallmo, ed. Mule and black-tailed deer of North America. Univ. Nebraska Press, Lincoln.

Walton, K.C., 1988. "Environmental Fluoride and Fluorosis in Mammals," Mammal Reviews Vol. 18, No. 2, pp. 77-90.

Washington Administrative Code (WAC), 1991. “Class B Toxic Air Pollutants and Acceptable Source Impact Levels,” 173-460-160, September 1991.

Washington Administrative Code (WAC), 1994. “Known , Probable, and Potential Human Carcinogens and Acceptable Source Impact Levels,” 173-460-150, February 1994.

Welch, B.L., 1983. "Big Sagebrush: Nutrition, Selection, and Controversy," Proceedings of the First Utah Shrub Ecology Workshop, Ephraim, UT. K.L. Johnson, ed. Logan, UT: College of Natural Resources, Utah State University, 1983. pp. 21-33.

Welhan, J., and Meehan, C., 1994. "Hydrogeology of the Pocatello Aquifer: Implications for Wellhead Protections Strategies, in Hydrogeology, Waste Disposal, Science and Politics Proceedings 30th Symposium, Engineering Geology and Geotechnical Engineering."

White, D.H. and M.T. Finley, 1978. "Uptake and Retention of Dietary Cadmium in Mallard Ducks," Environmental Research, Vol. 17, pp. 53-59.

Whitehead, R. L., 1986. “Geohydrologic framework of the Snake River Plan, Idaho and eastern Oregon,” U.S. Coal Summary Hydrologic Atlas HA-682.

Wilson, R., 1992. Personal correspondence between Messrs. Robert Wilson and Bill Ryan of U.S. EPA Region 10 and Bill Adams of U.S. EPA Region 10, August, 1992.

Wood, W.W., and W.H. Low, 1986. "Aqueous Geochemistry and Diagenesis in the Eastern Snake River Plain Aquifer System, Idaho,” Geological Society of America Bulletin, Vol. 97, pp. 1456-1466.

Wolleson, Ward, 1992a. Personal communication between Kathleen Pahl of Bechtel Environmental, Inc., and W. Wolleson of J.R. Simplot, September 8, 1992.

Wolleson, W., 1992b. Personal communication between Ward Wolleson of J.R. Simplot and Marcey Manning of Bechtel Environmental, Inc.

Woodward-Clyde, 1993. "Ecological Risk Screening Study for SF Phosphates," Prepared for SF Phosphates Limited Co. Rock Springs, Wyoming. July 1.