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EPA Office of Compliance Sector Notebook Project

Profile of the Water Transportation Industry

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Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
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Electronic versions of all Sector Notebooks are available via Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

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Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Questions relating to the Sector Notebook Project can be directed to:

Seth Heminway, Coordinator, Sector Notebook Project
US EPA Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document No.	Industry	Contact	Phone
EPA/310-R-95-001	Dry Cleaning Industry	Joyce Chandler	(202) 564-7073
EPA/310-R-95-002	Electronics and Computer Industry	Steve Hoover	(202) 564-7007
EPA/310-R-95-003	Wood Furniture and Fixtures Industry	Bob Marshall	(202) 564-7021
EPA/310-R-95-004	Inorganic Chemical Industry	Walter DeRieux	(202) 564-7067
EPA/310-R-95-005	Iron and Steel Industry	Maria Malave	(202) 564-7027
EPA/310-R-95-006	Lumber and Wood Products Industry	Seth Heminway	(202) 564-7017
EPA/310-R-95-007	Fabricated Metal Products Industry	Scott Throwe	(202) 564-7013
EPA/310-R-95-008	Metal Mining Industry	Jane Engert	(202) 564-5021
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EPA/310-R-95-010	Nonferrous Metals Industry	Jane Engert	(202) 564-5021
EPA/310-R-95-011	Non-Fuel, Non-Metal Mining Industry	Robert Lischinsky	(202) 564-2628
EPA/310-R-95-012	Organic Chemical Industry	Walter DeRieux	(202) 564-7067
EPA/310-R-95-013	Petroleum Refining Industry	Tom Ripp	(202) 564-7003
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EPA/310-R-97-001	Air Transportation Industry	Virginia Lathrop	(202) 564-7057
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EPA/310-R-97-003	Water Transportation Industry	Virginia Lathrop	(202) 564-7057
EPA/310-R-97-004	Metal Casting Industry	Jane Engert	(202) 564-5021
EPA/310-R-97-005	Pharmaceuticals Industry	Emily Chow	(202) 564-7071
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EPA/310-R-97-008	Shipbuilding and Repair Industry	Anthony Raia	(202) 564-6045
EPA/310-R-97-009	Textile Industry	Belinda Breidenbach	(202) 564-7022
EPA/310-R-97-010	Sector Notebook Data Refresh, 1997	Seth Heminway	(202) 564-7017

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LIST OF EXHIBITS

LIST OF ACRONYMS

AFS	AIRS Facility Subsystem (CAA database)
AIRS	Aerometric Information Retrieval System (CAA database)
BIFs	Boilers and Industrial Furnaces (RCRA)
BOD	Biochemical Oxygen Demand
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	CERCLA Information System
CFCs	Chlorofluorocarbons
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSI	Common Sense Initiative
CWA	Clean Water Act
D&B	Dun and Bradstreet Marketing Index
ELP	Environmental Leadership Program
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS	Facility Indexing System
HAPs	Hazardous Air Pollutants (CAA)
HSDB	Hazardous Substances Data Bank
IDEA	Integrated Data for Enforcement Analysis
LDR	Land Disposal Restrictions (RCRA)
LEPCs	Local Emergency Planning Committees
MACT	Maximum Achievable Control Technology (CAA)
MCLGs	Maximum Contaminant Level Goals
MCLs	Maximum Contaminant Levels
MEK	Methyl Ethyl Ketone
MSDSs	Material Safety Data Sheets
NAAQS	National Ambient Air Quality Standards (CAA)
NAFTA	North American Free Trade Agreement
NCDB	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC	National Enforcement Investigation Center
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_2	Nitrogen Dioxide
NOV	Notice of Violation
NO_X	Nitrogen Oxide
NPDES	National Pollution Discharge Elimination System (CWA)
NPL	National Priorities List

LIST OF ACRONYMS (CONTINUED)

NRC	National Response Center
NSPS	New Source Performance Standards (CAA)
OAR	Office of Air and Radiation
OECA	Office of Enforcement and Compliance Assurance
OPA	Oil Pollution Act
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
OSHA	Occupational Safety and Health Administration
OSW	Office of Solid Waste
OSWER	Office of Solid Waste and Emergency Response
OW	Office of Water
P2	Pollution Prevention
PCS	Permit Compliance System (CWA Database)
POTW	Publicly Owned Treatments Works
RCRA	Resource Conservation and Recovery Act
RCRIS	RCRA Information System
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEPs	Supplementary Environmental Projects
SERCs	State Emergency Response Commissions
SIC	Standard Industrial Classification
SO_2	Sulfur Dioxide
SO_X	Sulfur Oxides
TOC	Total Organic Carbon
TRI	Toxic Release Inventory
TRIS	Toxic Release Inventory System
TCRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
UIC	Underground Injection Control (SDWA)
UST	Underground Storage Tanks (RCRA)
VOCs	Volatile Organic Compounds

WATER TRANSPORTATION INDUSTRY (SIC 44)

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Integrated environmental policies based upon comprehensive analysis of air, water and land pollution are a logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/ outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was originally initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded to its current form. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each

profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process who enabled us to develop more complete, accurate and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

I.B.1. Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW, (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing this system. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

I.B.2. Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. The Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting in

the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. Introduction to the Water Transportation Industry

This section presents the water transportation operations covered in this document and defines those operations in terms of their Standard Industrial Classification (SIC) code. It also provides background information on the size, geographic distribution, and economic condition of the water transportation industry.

II.A. Introduction, Background, and Scope of the Notebook

This notebook pertains to the water transportation industry as classified within Standard Industrial Classification (SIC) code 44 (Water Transportation). (Please note that this section provides both the SIC code and the new North American Industrial Classification System [NAICS] code [in parenthesis], which went into effect January 1, 1997. While the NAICS code is identified in this section, the remainder of the document still refers to the SIC codes for specific water transportation activities.) The transportation industry includes other modes of transport such as trucking, railroad, pipeline, and airplane. Although these are not addressed in this document, they make up an important portion of overall transportation activity in the United States.

The transportation industry affects nearly every American. Either through the necessity of traveling from one place to another, shipping goods and services around the country, or working in a transportation-related job, transportation's share of the national economy is significant. According to the Eno Transportation Foundation, for all transportation-related industries, total transportation expenditures in the U.S. accounted for 16.1 percent of the gross national product in 1993.

The water transportation industry (SIC 44, NAICS 44) includes establishments engaged in freight and passenger transportation on the open seas or inland waters and establishments furnishing such incidental services as lighterage, towing, and canal operations. This group also includes excursion and sightseeing boats, water taxis, and cargo handling operations. Specifically, this notebook includes the following groups:

SIC 4412 (NAICS 483111) - Deep Sea Foreign Transportation of Freight. Establishments primarily engaged in operating vessels for the transportation of freight on the deep seas between the United States and foreign ports. Establishments operating vessels for the transportation of freight that travel to foreign ports and also to noncontiguous territories are classified in this industry.

SIC 4424 (NAICS 483113)- Deep Sea Domestic Transportation of Freight. Establishments primarily engaged in operating vessels for the transportation of freight on the deep seas between ports of the United States, the Panama Canal Zone, Puerto Rico, and United States island possessions or protectorates. Also included are operations limited to the coasts of Alaska, Hawaii, or Puerto Rico.

SIC 4432 (NAICS 483113) - Freight Transportation on the Great Lakes--St. Lawrence Seaway. Establishments primarily engaged in the transportation of freight on the Great Lakes and the St. Lawrence Seaway, either between United States ports or between United States and Canadian ports.

SIC 4449 (NAICS 483211) - Water Transportation of Freight, N.E.C. Establishments primarily engaged in the transportation of freight on all inland waterways, including the intracoastal waterways on the Atlantic and Gulf coasts.

SIC 4481 (NAICS 483112 and 483114) - Deep Sea Transportation of Passengers, Except by Ferry. Establishments primarily engaged in operating vessels for the transportation of passengers on the deep seas.

SIC 4482 (NAICS 483114 and 483212) - Ferries. Establishments primarily engaged in operating ferries for the transportation of passengers or vehicles.

SIC 4489 (NAICS 483212 and 48721) - Water Transportation of Passengers, N.E.C. Establishments primarily engaged in furnishing water transportation of passengers, not elsewhere classified, such as airboats (e.g., swamp buggy rides), excursion boat operations, and sightseeing boats.

SIC 4491 (NAICS 48831 and 48832) - Marine Cargo Handling. Establishments primarily engaged in activities directly related to marine cargo handling, from the time cargo for or from a vessel arrives at shipside, dock, pier, terminal, staging area, or in-transit area until cargo loading or unloading operations are completed. Included in this industry are establishments primarily engaged in the transfer of cargo between ships and barges, trucks, trains, pipelines, and wharfs. Cargo handling operations carried on by transportation companies and separately reported are classified here. This industry includes the operation and maintenance of piers, docks, and associated buildings and facilities.

SIC 4492 (NAICS 483113, 483211, and 48833) - Towing and Tugboat Services. Establishments primarily engaged in furnishing marine towing

and tugboat services in the performance of auxiliary or terminal services in harbor areas. The vessels used in performing these services do not carry cargo or passengers.

SIC 4493 (NAICS 71393) - Marinas. Establishments primarily engaged in operating marinas. These establishments rent boat slips and store boats, and generally perform a range of other services, including cleaning and incidental boat repair. They frequently sell food, fuel, and fishing supplies, and may sell boats.

SIC 4499 (532411, 48831, 48833, and 48839) - Water Transportation Services, N.E.C. Establishments primarily engaged in furnishing miscellaneous services incidental to water transportation, not elsewhere classified, such as lighterage; boat hiring, except for pleasure; chartering of vessels; canal operation; ship cleaning, except hold cleaning; and steamship leasing.

II.B. Characterization of the Water Transportation Industry

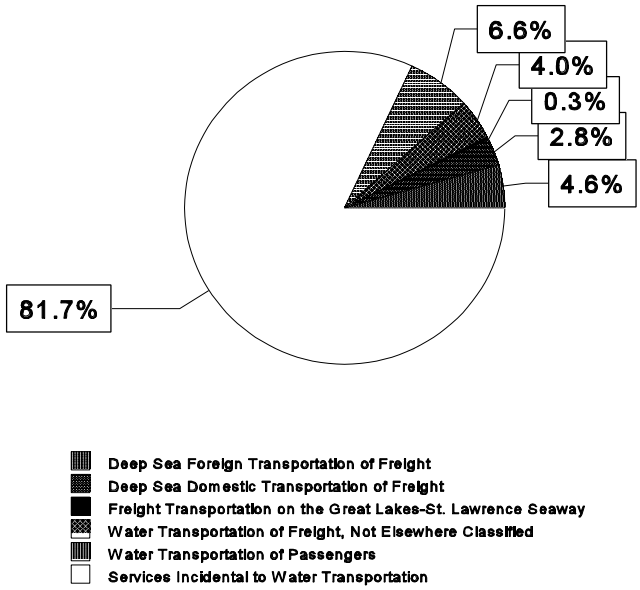
II.B.1. Industry Characterization

Ever since people learned that certain materials float on the water, they have used those materials as a means of moving goods and themselves from one place to another. What probably started as simple pieces of wood have now, through technology and science, grown into multi-million pound tankers and barges that transport literally millions of tons of goods and people across the United States and the world. With the creation of these huge, high-powered vessels came the need to service them and provide a place for loading and unloading their cargo. To support these huge vessels, marine facilities have sprung up in strategic locations across the country, such as at the mouths of bays and rivers. It is these two primary topics - vessels and marine facilities - and the activities and operations that occur within each of these areas that are the primary focus of this notebook.

Vessels

Generally, this sector can be divided into two distinct groups - self propelled vessels and barges. Self-propelled vessels have on-board propulsion systems that are either steam or diesel powered. Barges must rely on other means for movement (e.g., tugboats, pushboats). Within these two categories, the vessels can be defined by three general types:

Exhibit 1. Percentage of Establishments by SIC Code



- General cargo vessels are traditional multipurpose freighters that carry nonuniform items that are packaged as single parcels or assembled together on pallet boards. Cargo is typically lifted on and off the vessels using a crane and wire or rope slings.

- Bulk carriers are vessels that carry homogenous unpacked cargo, usually in shipload lots. There are two types of bulk carriers: 1) dry bulk carriers - designed to carry dry bulk commodities such as grain or ore, and 2) tankers - designed to carry liquid commodities such as oil or petroleum products.

- Intermodal vessels include container vessels and roll-on/roll-off (RO/RO) vessels. Container vessels are designed to carry cargo in standard size preloaded containers that permit rapid loading and unloading and efficient transportation of the cargo to and from the port. In many cases, these containers may be railroad cars or similar sized containers that are loaded or unloaded directly from railroad cars or trucks. RO/ROs allow cars or other vehicles to be driven directly on or off the vessel.

Marine Facilities

Marine facilities are much different than the wooden docks that once served the loading and unloading function for early America. Today, the shoreline contains sophisticated marine facilities that contain state-of-the-art technology and the latest in cargo-handling equipment. Computerized cargo equipment, such as cranes, load and unload vessels at a rapid pace; computerized gates tell drivers which lanes and piers to go to; and remote

intercoms send and receive messages from drivers to clerks to gatehouse guards. These marine facilities also include thousands of square feet of warehouse space, equipment storage yards, and grain elevators. In some cases, these facilities include maintenance and repair shops, including stripping/painting operations, engine repair shops, and machine shops.

Exhibit 1 provides information on the percentage of establishments in each of the SIC codes examined in this notebook; Exhibit 2 presents further information by SIC codes, including the number of establishments, total number of employees, and total annual sales.

Exhibit 2. SIC Code Major Group 44 Market Analysis

SIC Code	Number of Establishments	Total Numbers of Employees	Total Annual Sales (in millions)
4412	618	17,641	19,106
4424	367	7,429	4,917
4432	46	878	416
4449	531	17,548	3,598
4481	107	11,485	5,679
4482	130	2,855	149
4489	639	9,720	1,154
4491	1,198	23,767	3,627
4492	1,056	16,137	2,470
4493	6,334	29,931	1,858
4499	2,303	18,850	1,293
Totals	13,329	156,241	44,267

Source: D&B Marketplace (www.dnb.imarketinc.com), 1997

II.B.2. Industry Size and Geographic Distribution

Vessels

As of December 31, 1995, there were nearly 40,000 U.S.-flag vessels. Being a U.S.-flag vessel means the vessel is registered in the United States; it does not mean the vessel was built in the U.S., nor does it mean the vessel is owned or operated by a U.S. citizen. By being registered in the U.S., the vessel is subject to additional U.S. laws and regulations, including environmental laws and regulations, to which foreign-flag vessels are not subject. Of these nearly 40,000 vessels, 31,360 are barges (i.e., not self-propelled). Exhibit 3 provides a detailed breakdown of the vessels by type.

Exhibit 3. U.S.-flag Vessels as of December 31, 1995

Vessel Type	Number
Self-propelled (total)	8,281
Dry cargo	726
Tanker	178
Pushboat	1,328
Tugboat	3,799
Passenger	954
Offshore supply	1,288
Unknown	8
Barge (total)	31,360
Dry cargo	27,342
Tanker	3,985
Railroad car floats	33
Total self-propelled and barge	39,641

Source: U.S. Army Corps of Engineers, December 1995

Water transportation occurs in, and is defined by, three basic geographic areas: 1) coastal, which is from one coastal port to another and can be either domestic or foreign (e.g., New York to Miami, or New York to Hong Kong), 2) Great Lakes, which also can be either domestic or foreign, and 3) inland, which is riverways and lakes of the U.S. only. Exhibit 4 presents data on the activities that occur within each of these three geographic areas. Exhibit 5 identifies the top 15 states based on waterborne traffic, combined domestic and foreign, and provides quantitative data on the tons transported and the percent difference from the previous year.

Exhibit 4. Geographic Distribution of U.S. Waterborne Activities, 1995 [1]

Activity	Coastal [2]	Great Lakes	Inland
Number of ports handling more than 250,000 tons	120	51	23
Domestic traffic			
Tons (millions)	267	116	620
Ton-miles (billions)	440	59	306
Average haul (miles)	1,651	514	493
Foreign traffic [3]			
Tons (millions)	1,095	52	N/A
Ton-miles (billions)	75	32	N/A
Average haul (miles)	68	610	N/A

1. Source: U.S. Army Corps of Engineers, December 1996.
2. All deep draft (more than 12 feet), except Great Lakes and Columbia River
3. Ton-miles and average haul for coastal ports are based on the distance transported on U.S. waterways from entrance channels to ports and waterways. For Great Lakes ports, numbers are based on the distance transported on the Great Lakes and St. Lawrence River to the international boundary at St. Regis, Quebec, Canada.

Marine Facilities

According to the U.S. Army Corps of Engineers, there are more than 9,000 marine facilities in the United States (see Exhibit 6). Of these, the Corps has identified approximately 177 commercial cargo ports, which each handle more than 250,000 tons of cargo annually. (See Exhibit 6 for the geographic distribution of these ports.) Such ports are usually under the auspices of a city, county, or state taxing authority. The Maritime Administration reports there are 1,941 public and private ports in the U.S. with the capacity to berth 3,214 ships, and transport 95 percent of America's international trade. The remainder of the facilities includes

marinas and other water transportation services. Exhibit 6 presents information on the location and type of the more than 9,000 marine facilities.

Exhibit 5. U.S. Waterborne Traffic by State - Top 15 States, 1995
(Millions of Tons and Percent Change from 1994)

State	Domestic		Foreign	
	Million Tons	Percent Change	Million Tons	Percent Change
Louisiana	277	5.0	230	7.9
Texas	125	1.0	225	(2.4)
California	86	(6.8)	93	2.5
Ohio	103	(4.6)	20	13.3
Pennsylvania	76	(0.9)	46	4.0
Washington	57	5.0	65	28.6
Florida	72	(4.5)	45	(0.4)
Illinois	112	3.7	3	(17.3)
Alaska	90	(3.5)	9	5.7
New Jersey	58	(2.5)	40	4.3
New York	53	(6.5)	29	(13.0)
Indiana	77	(0.5)	4	42.7
Virginia	23	4.8	57	16.0
Kentucky	79	(9.5)	0	0
West Virginia	79	6.3	0	0
Source: U.S. Army Corps of Engineers, December 1996				

II.B.3 Economic Trends

Over the past 20 years, the amount of waterborne commerce conducted domestically has remained relatively constant. Since 1976, the total tons transported domestically has risen from 976 million tons to 1,086 million tons, or approximately 10 percent. Over that time, there have been no significant rises or falls. On the foreign side, total commerce has increased

Exhibit 6. Geographic Distribution of U.S. Marine Facilities

Type of Commercial Facility	Atlantic	Gulf	Pacific	Great Lakes	Inland	Total
Cargo	1219	1242	886	455	1706	5508
Service	820	893	775	214	467	3169
Unused	241	154	106	74	195	770
Total	2280	2289	1767	743	2368	9447

Source: U.S. Army Corps of Engineers, December 1996

more than 25 percent from 856 million tons in 1976 to 1,147 million tons in 1995. This increase occurs over the same period in which the total number of U.S.-flag ocean-going vessels decreased by more than half. This can be attributed to several things, including the increased size of ships. In total, waterborne commerce, domestic and foreign combined, has increased more than 20 percent since 1976. Exhibit 7 presents more data on waterborne commerce; Exhibit 8 presents this data graphically from 1986 to 1995.

Exhibit 7. Total Waterborne Commerce, 1976 - 1995
(in million tons)

Year	Domestic	Foreign	
1976	976.1	856.0	1832.1
1977	969.3	935.3	1904.6
1978	1072.0	946.1	2018.1
1979	1076.3	993.4	2069.7
1980	1073.9	921.4	1995.3
1981	1051.3	887.1	1938.4
1982	954.2	819.7	1773.9
1983	953.4	751.1	1704.5
1984	1029.3	803.3	1832.6
1985	1010.7	774.3	1785
1986	1033.2	837.2	1870.4
1987	1071.8	891.0	1962.8

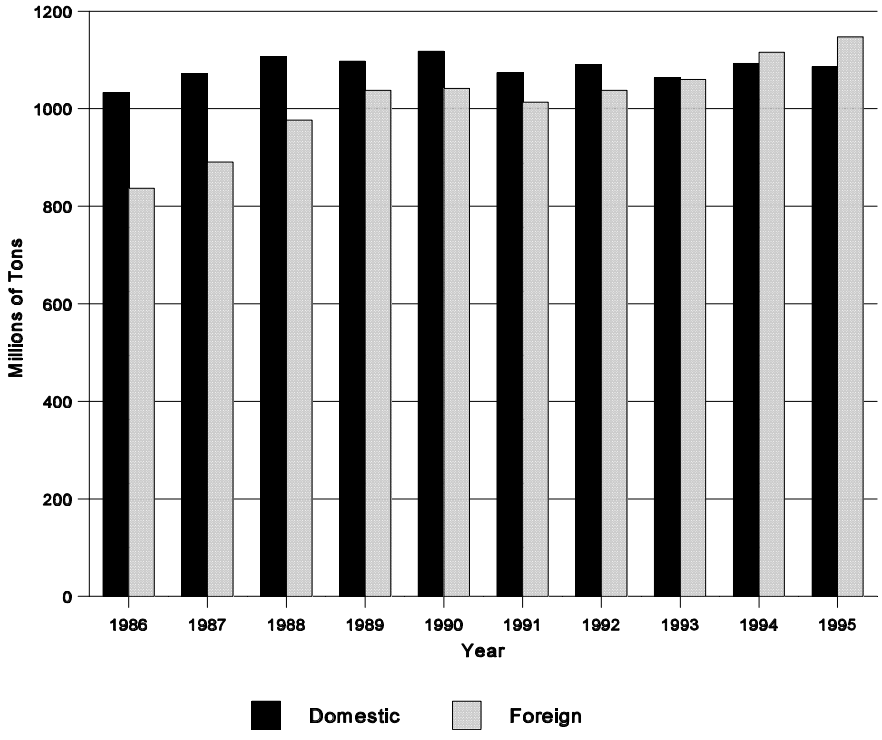
Exhibit 7. Total Waterborne Commerce, 1976 - 1995
(in million tons)

Year	Domestic	Foreign	Total
1988	1106.6	976.2	2082.8
1989	1097.3	1037.9	2135.2
1990	1117.8	1041.6	2159.4
1991	1074.0	1013.6	2087.6
1992	1090.4	1037.5	2127.9
1993	1063.2	1060.0	2123.2
1994	1093.1	1115.7	2208.8
1995	1086.2	1147.4	2233.6

Source: U.S. Army Corps of Engineers, 1996

As shown previously in Exhibit 2, the water transportation industry sector accounts for nearly $45 billion in annual sales. Of that $45 billion, nearly

Exhibit 8. Total Waterborne Commerce
Both Foreign and Domestic, 1986 - 1995



43 percent of those annual sales are earned by the 618 establishments classified as SIC code 4412 (Deep Sea Foreign Transport). As a part of that SIC code, the Maritime Administration reports that the privately owned U.S. deep sea foreign transport fleet (371 vessels) is the ninth largest in the world by deadweight tonnage. This constitutes about 3 percent of the world fleet. Overall, U.S.-flag vessels carry only about 4 percent of all international cargo.

The U.S. is the world's largest trading nation, with more than $1 trillion in trade in 1993. Nearly 50 percent of this trade, by value, was transported by sea. Throughout much of this century, the U.S. merchant marine industry has struggled to compete effectively in the international market. This may be due to the fact that U.S.-flag ships are more expensive to use. The Maritime Administration reports that U.S. flag vessels generally have higher operating and capital costs than foreign-flag vessels and that crew costs are the primary reason for this. U.S. crews receive higher wages and other benefits, and U.S.-flag vessels have higher manning levels. In addition, U.S. shipyards charge more to build and maintain ships. To help the U.S. merchant marine industry compete, the U.S. Congress passed preference cargo laws, which state that most government-owned or financed cargo that is shipped internationally must be carried aboard U.S.-flag vessels. This is known as preference cargo. This promotes the U.S. industry because U.S.-flag vessels are required to be staffed by U.S. mariners, are generally required to be built in the U.S., and are encouraged to be maintained and repaired in the U.S.

III. WATER TRANSPORTATION OPERATIONS AND MAINTENANCE

This section provides an overview of commonly-employed operations and maintenance activities within the water transportation industry. This discussion is not exhaustive; it is intended to represent the major sources of environmental hazards from vessel and marine terminal operations. The following sections discuss both vessel operations, including on-board life, bilge pumping, tank cleaning, ballasting, power generation, fueling, and marine facility operations, including vessel maintenance, on-shore tanks, fueling, and cargo handling.

III.A. Vessel Operations

III.A.1. On-board Life

The routine, daily operation of any vessel results in the same types of domestic wastes that exist in any household. Sanitary wastes generated by humans are collected in toilets and other such receptacles. Domestic wastes consist of food remains, water from sinks and showers, and laundries. Both types of waste are pumped into holding tank(s) usually located at the bottom of the vessel.

Raw Material Input and Pollution Output

Sanitary and domestic wastes generated onboard a vessel are usually discharged into the water when the holding tank becomes full. Sewage can be very detrimental to the waterways because of its high content of coliform bacteria, low pH levels, and high BOD. However, because it is both economically beneficial and simple, the raw sewage is often discharged directly into the sea. The MARPOL Convention established limits (i.e., miles from shore) for such discharges. These requirements are discussed in more detail in Section V.B - Water Transportation Industry Specific Requirements.

III.A.2. Bilge Pumping

The bilge, which is a collection area located at the bottom of any vessel, collects fuel, oil, on-board spills, and wash waters generated during the daily operation of any vessel. Bilge water also may contain solid wastes, such as rags, metal shavings, paint, glass, and cleaning agents. Bilge waste is pumped to a bilge waste holding tank on the vessel when the level in the bilge gets too high for safe operation (usually one foot). Accumulation and rate of discharges of bilge vary from vessel to vessel.

Raw Material Input and Pollution Output

The pollutants in bilge contain high amounts of BOD, COD, dissolved solids, oil, and other chemicals that accumulate as a result of routine operation. Once in port, a vessel must discharge all bilge and other vessel tanks to onshore tanks usually supplied by the marine facility. Unfortunately, vessels sometimes discharge the contents of the bilge tank directly into the waterway.

III.A.3. Tank Cleaning

After a tanker has unloaded its cargo, all cargo tanks must be cleaned to remove any residue left by the cargo. The degree to which the tanks are cleaned usually depends on the nature of past and future cargos carried on the vessel. Cargos that are compatible (e.g., grains, ores, or petroleum products) may not require as strenuous a cleaning as those cargos that should not be mixed. A high-pressure water spray is the primary method for tank cleaning. Usually, the spray system uses a "Butterworth" nozzle, which releases the pressurized multidirectional spray in both a vertical and horizontal plane that allows the entire tank to be reached by the spray. The pressurized water spray system is either operated by a person, or some vessels are now equipped with automated systems. Upon completion of the high-pressure cleaning, the washwater is pumped into a "slop" tank where it is held until discharged on shore. On oil tankers, the slop tank is pumped back to the cargo tank prior to receipt of a new shipment of oil. This is called "load on top." In addition to cargo changes, other reasons for tank cleaning may include routine maintenance and control of residue buildup, preparation for repair or other maintenance, and preparation for ballast.

Raw Material Input and Pollution Output

Tank cleaning results in significant amounts of wash water that must be held in the "slop" tank until discharged on shore. In the case of oil tankers, this wash water is combined with oily residue. These wastes could be either directly discharged to the sea, or could spill during transfer or collection, or spill on the vessel and be included as part of bilge waste.

III.A.4. Ballasting

Ballasting is the use of water as "cargo" to give the ship maneuverability and stability at sea. In ballasting, seawater is used as a replacement to an off-loaded cargo (e.g., oil) and supplies the weight to place the vessel at the proper draft for its return trip (without cargo). In the case of oil tankers, after the original cargo is unloaded at its final destination, the tanks that held the oil are filled with seawater to act as ballast. As the oil residue left

in the tanks rises to the top, the seawater below the oil is discharged back to sea leaving only the oil residue in the tank. The new cargo is then "loaded on top" of the remaining oil residue. (In addition to new cargo, the vessel may discharge its slop tank into the cargo tank prior to receiving new cargo.) Some vessels are equipped with segregated ballast and able to bypass the entire process of disposing of dirty ballast water.

Raw Material Input and Pollution Output

During ballasting, the clean seawater mixes with the residue in the tanks to form dirty ballast. After the pollutants separate from the water (either rising to the top of the tanks in the case of oil, or settling to the bottom), the separated ballast water is discharged. There is a potential for spills of the dirty ballast if its release is not managed carefully and properly.

III.A.5. Power Generation

The self-propelled vessels of today are primarily powered by diesel engines. However, there are still numerous vessels that rely on steam to power their propulsion system. Approximately half of the U.S. ocean-going fleet is steam-powered. Steam-powered vessels are less efficient and use more fuel than the newer diesel-powered vessels that comprise virtually all of the foreign flag vessels.

Raw Material Input and Pollution Output

Vessel emissions consist primarily of suspended particulates, carbon monoxide, sulfur dioxide, and some nitrogen oxides from propulsion and auxiliary boilers and engines. Coal-fired boilers generate a significant amount of particulates. Heavy particulate emissions also are generated when carbon deposits are blown from the air preheater and superheated tubes in oil- and coal-fired boilers.

It is generally assumed that the pollution load from vessels in a metropolitan air shed is substantially lower than that from other sources such as stationary power-generating plants, automobiles, and industry ashore. At present, it appears boat and ship air emissions are not considered serious polluters because such emissions are minimal compared to the emissions of other sources.

III.A.6. Fueling

There are several ways vessels receive fuel. Many vessels are able to take on fuel directly from a marine facility. Others, because of their size and draft, are not able to pull into a port or other marine facility to refuel. This creates the need for the fuel to be taken to the vessels by specially-designed tanker vessels. This type of refueling occurs via a series of hoses that transport fuel from one vessel to the other.

Raw Material Input and Pollution Output

There are several types of fuel that are used to power vessels. These fuels, if spilled into the water or onto one of the decks of either vessel during a fueling operation, may result in significant environmental impacts if not properly contained. Air and water pollution resulting from fuel spillage are the major environmental concerns associated with fueling operations. The possibility of accidental spillage, however, is substantially reduced by maintaining fuel tanks, lines, and fueling systems.

III.B. Marine Facility Operations

III.B.1. Vessel Maintenance

Painting a vessel to improve appearance and performance and to prevent corrosion and marine organism growth is an important maintenance practice. Prior to applying new paint, however, the surface must be cleaned and the old paint removed. This usually occurs by using a chemical paint stripper to remove the old paint. The most common strippers are based on methylene chloride. Another option is abrasive blasting. Blasting is used primarily because the blasting medium is not hazardous; it may be garnet, flint grit, or steel shot.

The actual painting of a vessel is usually performed using a spray system, although some parts may be hand painted. Oil-based antifouling paints used on the hulls of vessels are toxic in nature to reduce marine organism growth and require solvents as propellants (if sprayed on) and for cleanup of painting equipment. For this reason, special handling of the paint and equipment is necessary. Water-based paints are commonly used on the parts of the vessel that do not come in contact with sea water.

Engine repairs and other types of vessel repairs also may be performed at the marine facilities. Engine repairs may vary from small automotive-type engines of smaller vessels to repairs on large boilers and turbines of tankers or other cargo vessels. These repairs result in the same types of waste as those at any auto maintenance shop - spent lube and engine oils, solvents, batteries, and coolants. Other repairs may include sheet metal work, metal finishing, or other specialty operations.

Raw Material Input and Pollution Output

Many of the services provided through the marine facilities involve the use of materials and operations that are used in other service industries, including automobile repair, painting services, and body shops. Typical materials used and the resulting wastes are identified in Exhibit 9.

Exhibit 9. Vessel Maintenance Operations, Raw Material Inputs, and Pollution Outputs

Operation	Raw Material Input	Pollution Output
Paint removal	Chemical paint strippers, blast media	Wastewater containing blasting media, organic paint sludges, heavy metals, stripping chemicals, VOCs
Painting	Antifouling paints	Waste paints, thinners, degreasers, solvents, resins and gelcoat, VOCs
Engine repair	Degreasing solvents, carburetor cleaner	Waste turbine oil, lubricants, degreasers, mild acids, batteries, carburetor cleaners, VOCs
Machine shop	Solvents, cutting fluids, degreasing acids and alkalies,	Spent cutting and lube oils, scrap metal, degreasers, VOCs
Metal finishing	Cyanide, heavy metal baths, acids and alkalies.	Cyanide solutions, heavy metal sludges, corrosive acid, and alkali solutions

III.B.2. Onshore Tanks

Most marine terminals have holding tanks on site into which wastes from vessels are pumped. For example, the contents of a slop tank may be discharged to these onshore tanks once a vessel reaches shore. According to the Shipbuilders Council of America, a typical shipyard processes more than 1 million gallons of bilge slops a year. A large facility may generate significantly more. For example, Norfolk Shipbuilding and Drydock Corporation processed 6.6 million gallons of slops in 1990. In addition, these tanks act as repositories for any liquid wastes generated at the marine terminal (e.g., wash water from painting and cleaning operations).

Raw Material Input and Pollution Output

Raw sewage, domestic waste, oily water waste, and contaminated water are discharged from vessels into onshore tanks. Wastes from onshore operations also may be disposed of in these tanks. Vacuum trucks are used to extract the waste from these tanks and transport it to a place for proper disposal so there are no pollution outputs. Or, in some cases, these tanks may be connected to a sewer or on-site waste treatment plant.

III.B.3. Fueling

An essential part of any marine facility operation is fueling the equipment used for cargo handling. These functions are usually accomplished either by tank trucks or a central underground fueling system and are similar to those at an automobile gas station.

Raw Material Inputs and Pollution Outputs

Air and water pollution resulting from fuel spillage are the major environmental concerns associated with fueling operations. The possibility of accidental spillage, however, is substantially reduced by maintaining fuel tanks, lines, and fueling systems. Fueling accomplished by large vehicular carriers can discharge oil and petroleum wastes into water bodies through spills. Fuel emissions from this type of fueling introduces pollutants into the air.

Underground fueling systems that are not maintained properly can leak and eventually contaminate groundwater. Large fuel spills present an extremely hazardous fire potential and are usually remediated by blanketing with foam and washing the material away with water. Any residue remaining is allowed to evaporate before the area is again used for normal operations. The substances in the wastewater are regulated water pollutants, so wash waters must be processed in a way that is consistent with Clean Water Act (CWA) requirements. In most cases, the State has authority for enforcement of CWA provisions and permit administration. Treatment of wash waters may be required before release to a local sewer system or an outfall regulated by a National Pollutant Discharge Elimination System (NPDES) permit.

III.B.4. Cargo Handling

Marine facilities provide most of the port side services shipping lines require including loading and unloading of general cargo, bulk cargo, and intermodal cargo. General cargo is usually loaded and unloaded using standard equipment such as cranes, forklifts, pallets, tractors, and rope and

wire slings. General cargo vessels usually have several large hatches that provide access to the holds. There is separate equipment for each hatch--usually masts and booms or a rotating crane. At dock side, slings are attached to the cargo, which is then lifted aboard ship and transferred into the hold.

Bulk cargo operation terminals handle materials with advanced equipment, such as pneumatic continuous ship loaders and unloaders, belt conveyors, stockpiling and reclaiming machines, or use traditional methods of cranes with grab buckets and front-end loaders. A standard operation consists of conveyors running from the storage area to the shipping dock. The belt conveyors discharge to a conveyor running parallel to the dock, which discharges to a bucket conveyor that lifts the product up to the top of the loading crane and then out over the water. The product is then dropped from the crane conveyor into the loading chute extending down to the hold. The chute extends only to the vessel's hatch, where the product falls to the bottom of the hold. A slinger is located on the bottom of the hold and throws the product to far reaches of the hold. Dry bulk cargo is loaded and unloaded with little manpower, as longshoremen guide spouts and monitor equipment.

The pneumatic conveyor is a pipeline with an air mover located at one end. The air mover creates a current that moves the cargo through the pipeline to the receiver. Air-solids fluidized mixture is passed through a cyclone receiver that separates the solid particles from the air and then send the solids into the receiving storage facility. The advantages of a pneumatic conveyor include greater cleanliness; a very flexible suction and discharge hose; ability to safely handle explosives and corrosive material; and low labor costs and increased safety.

Containerized cargo is usually packed in large metal boxes and can weigh up to 30 tons when fully loaded. Cell guides direct the container during the loading and unloading process, and hold the container in place during shipping. Containers stowed on deck are lashed in place. The terminal operator moves incoming containers with straddle carriers, forklift trucks, or top loaders. Yard tractors and chassis are used to move the containers to the cranes. The containers are then lifted onto cell guides that are in place on the ship.

As the industry expands, the need to unload larger cargoes quicker and faster is more prevalent. There has been full implementation of intermodalism, which has led to more efficient use of storage areas; high-speed, larger capacity loading equipment; and entry gates that have a number of automated functions. New terminal designs have also been implemented to reduce time and cost. The container terminal design

includes construction of new integrated intermodal container transfer facilities adjacent to or directly on terminal sites.

Roll-on/Roll-off cargo is driven on and off the vessel using ramps on the sides. These ships are able to handle any size cargo. Cargo unable to be driven onto the ship is put on flats and then loaded.

Hazardous cargo requires certain specifications, including separation from other cargo by cofferdam, void space, cargo pump room, or empty tanks. The cargo should also have pumping and piping systems separated from the other cargo, along with separate tank vent systems. The cargo should not be stored in either the fore or aft peaks.

Raw Material Input and Pollution Output

The majority of the raw materials and wastes associated with a marine facility are associated with the maintenance services that are provided to vessels. However, there are those environmental problems that occur as a result of cargo handling. A significant amount of diesel powered equipment is used in a typical marine facility, such as forklifts, tractors, and front-end loaders. Air emissions from these vehicles, when combined with those from vessels, as well as from trucks and trains that deliver and remove cargo, may contribute to nonattainment of certain air requirements.

As mentioned, there may be an abundance of tanks, both above and below ground, at marine facilities. These tanks present the possibility of leaks and spills, and may also release air emissions (e.g., VOCs) that are subject to air regulations. Excessive generation of particulate matter (e.g., dust or other particles) may occur as a result of cargo handling. Specifically, dry bulk cargo handling causes air, water, and solid waste pollution. The loading and unloading techniques used with this cargo produce high amounts of dust and solid waste accumulation.