APPENDIX A
NATIONAL RESPONSE SYSTEM CONCEPT

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300) establishes the National Response System (NRS) to foster effective and efficient preparedness for and response to oil and hazardous substance incidents wherever they might occur in the United States and its waters. The primary focus of the NCP and the NRS is protection of the environment from harm, or mitigation of that harm in the event of an oil or hazardous substance incident. The NCP establishes a tiered structure of planning and response, commonly referred to as the NRS. There are sixteen agencies listed as the primary federal participants in the NRS. The U.S. Environmental Protection Agency (USEPA) and the U.S. Coast Guard (USCG) share leadership responsibility in both planning and response at all levels. Other participating agencies include:

- U.S. Department of Commerce, National Oceanic and Atmospheric Administration
- U.S. Department of Interior
- U.S. Department of Agriculture
- U.S. Department of Defense
- U.S. Department of Energy
- U.S. Department of Health and Human Services
- U.S. Department of Justice
- U.S. Department of Labor
- U.S. Department of State
- U.S. Department of Transportation
- U.S. Department of Treasury
- Federal Emergency Management Administration
- General Services Administration
- Nuclear Regulatory Commission

The NCP establishes a National Response Team (NRT) for the country, Regional Response Teams (RRTs) for each region of the country, and dozens of local Area Committees.

The NRT is custodian of the NCP and provides broad policy and planning guidance; commits participating agencies to specific actions in supporting regional- and local-level preparedness, planning, and response efforts; and provides technical support and direction in evaluating new or innovative technologies and response concepts. All sixteen NRS agencies are standing NRT members and participate actively in all its missions.

Regional representatives of all sixteen NRS agencies are also active in each RRT. Each RRT maintains a Regional Contingency Plan (RCP), which provides regional-level preparedness planning and response guidance, including mechanisms for sharing resources among local communities, and, in conjunction with Area Committees, addresses environmental concerns related to region-specific response strategies. State response trustee agencies are critical members of each RRT and participate as equal members in all resource planning and use decisions that might affect their jurisdictions.

The local Area Committees develop Area Contingency Plans (ACPs) that detail community-specific response strategies. These response strategies are based on the risks faced at the local level, the resources available to combat those risks, and the potential impact on the local environment depending on which resources are employed, as well as how quickly and effectively those resources can be employed. Area Committees usually involve participation by subregional representatives from the sixteen NRS agencies, along with state and local response and environmental agencies.

In practice, the RRTs and Area Committees closely coordinate their activities to ensure that RCPs and ACPs are maintained and that the response strategies and tactics detailed in those plans are continuously assessed. Their focus is on maintaining healthy and effective response capabilities in the event of an oil or hazardous substance incident. All planning concepts in the RCPs and ACPs are subject to consensus of participating federal and state response and environmental agencies that the concepts, strategies, and tactics in these plans provide optimum protection of the environment and optimum mitigation of environmental impacts.

APPENDIX B
WHAT HAPPENS TO OIL WHEN IT IS SPILLED IN THE OCEAN ENVIRONMENT?[1]

B.1. INTRODUCTION

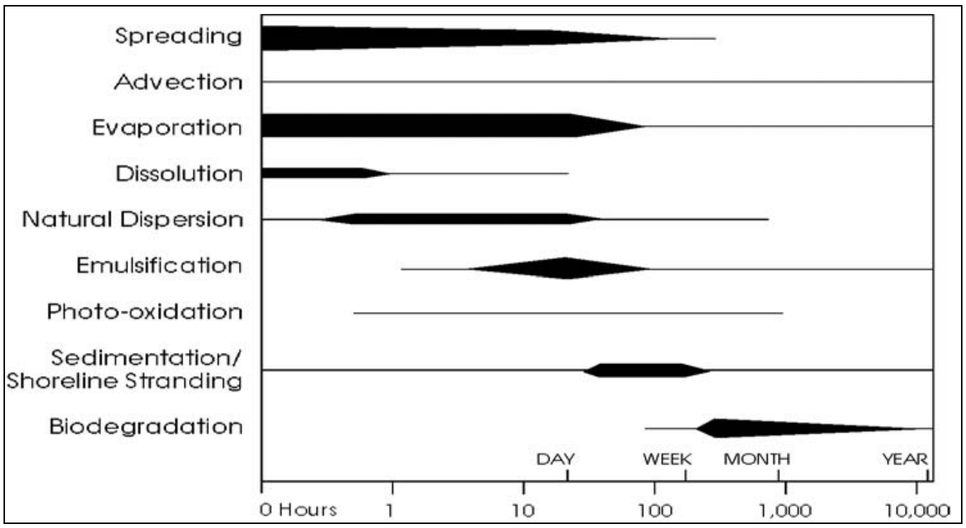
Environmental conditions and oil characteristics—including oil type, weather, wind, wave conditions, and air and sea temperatures—play important roles in the ultimate fate of spilled oil in the marine environment. After oil is discharged into the environment, a wide variety of physical, chemical, and biological processes begin to transform the discharged oil, changing its composition, behavior, routes of exposure, and toxicity. The collective action of these natural processes is called "weathering." There are ten major weathering processes, with brief descriptions being provided in the following subsections:

- Spreading
- Advection
- Evaporation
- Dissolution
- Natural dispersion
- Emulsification
- Photo-oxidation
- Sedimentation
- Shoreline stranding
- Biodegradation

[1] Appendix B is reproduced courtesy of the American Petroleum Institute from *Fate of Spilled Oil in Marine Waters: Where Does It Go? What Does It Do? How Do Dispersants Affect It?* (March 1999), pp. 10–31.

The description of each weathering process is organized according to the relative importance and chronology of each process, and is based on the assumption that there is an instantaneous, one-time release of oil offshore in a temperate environment. However, weathering processes often occur simultaneously, not in chronological order, and spill-specific conditions are important factors in determining the duration and significance of weathering processes. Figure B.1-1 shows the relative incidence and importance of individual weathering processes at different stages of the oil spill weathering process.

Figure B.1-1
Relative Prevalence and Importance of Weathering Processes over Time



Source: Reproduced courtesy of the American Petroleum Institute from *Fate of Spilled Oil in Marine Waters: Where Does It Go? What Does It Do? How Do Dispersants Affect It?* (March 1999), p. 11.

Note: The width of the bars in the graph represents the relative prevalence and importance of each process over time.

B.2. SPREADING AND ADVECTION

Spreading is the movement of an entire oil slick horizontally on the surface of the water because of the effects of gravity, inertia, friction, viscosity, and surface tension. On calm water, spreading usually occurs in a circular pattern outward from the center of the release point (CONCAWE, 1983). Advection is the movement of the oil due to the influence of overlying winds and underlying currents (NRC, 1985). Spreading and advection usually dominate the initial stages of a spill and involve the spill in its entirety, as they do not partition the various components of the oil or affect its chemical composition. They occur immediately following the release and continue for up to 1 week to 10 days depending on the size of the slick, or until the oil is contained by shorelines, collection efforts, or other obstructions. These processes increase the surface area of the oil, enhancing its exposure to air, sunlight, and underlying water, thereby increasing the potential for environmental impacts as well as the efficiency of other weathering processes (Exxon Corporation, 1985; Mielke, 1990).

Specific gravity and oil viscosity determine the spreading rate of oil, as heavier oils—thick, less fluid oils with high specific gravity and low API° gravity—do not spread as readily as lighter oils. Wind speed, sea state, and currents transport the oil on the water surface; wind determines the movement of the oil slick; sea state determines the breakup of the surface slick; and currents not only play a significant role in the movement of the oil on the water's surface, but also break up the surface slick into a series of thin parallel patches of oil. Oil pour point—the lowest temperature at which an oil or distillate fuel is observed to flow—is a factor in slowing or preventing spreading when the water temperature is below the oil's pour point. Water temperature affects spreading and advection by being a determining factor of oil viscosity and pour point. Finally, salinity directly influences the density of seawater and the buoyancy of oil, thereby affecting spreading and advection.

B.3. EVAPORATION

Evaporation is the preferential transfer of light- and medium-weight components of oil from the liquid phase to the vapor phase and into the atmosphere, in a process similar to that of gasoline evaporating quickly after accidentally being spilled. Thus, the chemical composition and volume of the oil slick are altered as the light- and medium-weight components evaporate from the spilled oil. The remaining components of the oil, after evaporation takes place, have a greater viscosity and specific gravity, which lead to a thickening of the oil and contribute to the formation of tar balls and tar mats (Lewis and Aurand, 1997).

Evaporation starts immediately following the discharge and continues for approximately 2 weeks and is the primary weathering process involved in the removal of oil from the water surface. The percentage of evaporation ranges from 20 to 40 percent for crude oils and up to 100 percent evaporation for refined products. The majority of evaporation occurs within the first 12 hours, and evaporation is the most important weathering process in terms of volume reduction during the first 24 to 48 hours (Payne and McNabb, 1984). Evaporation also affects the toxicity of the oil. Some of the most toxic medium-weight components undergo evaporation at a slow rate, remaining in the water long enough to pose a high risk of exposure to biological organisms.

Oil composition and oil volatility determine the evaporation rate of oil—the greater the proportion of components with low boiling points and of lightweight components, the greater the evaporation rate. Spreading enhances evaporation, as larger surface areas of oil exposed to the air increase the rate of evaporation; thus, thinner, bigger slicks will evaporate faster than thick, smaller slicks of the same oil type and volume. Solar radiation increases the oil's surface temperature, making the evaporative process more efficient as more components vaporize. Wind speed increases evaporation rates and, along with high sea states, can cause some of the oil to form a spray or mist, which also evaporates quickly. Finally, water temperature directly affects evaporation rates. If ambient water temperatures remain above the oil's pour point, the oil will remain fluid, which enhances the spreading process and thus the evaporation process.

B.4. DISSOLUTION

Dissolution is the transfer of oil components from a slick on the surface into solution in the water column. Certain lightweight components of the spilled oil tend to be the most soluble, and, therefore, the ones that dissolve first in the water column. Dissolution has a relatively insignificant effect on volume reduction since only a small fraction of the oil is removed by natural dissolution, because evaporation rates are significantly higher than dissolution rates and affect many of the same oil components that would otherwise eventually dissolve (CONCAWE, 1983; ITOPF, 1987; Lewis and Aurand, 1997; Neff, 1990). In addition, even after dissolution occurs, actual removal usually takes place through subsequent evaporation, biodegradation, or photo-oxidation (Mackay and McAuliffe, 1988). Dissolution typically occurs only within the first 24 hours after a spill occurs. The components of the oil that dissolve into the water column—ring-like structure and lightweight components—are typically the more acutely toxic components (NRC, 1985). Therefore, although only a very small amount of the spilled oil dissolves, the dissolved components become bioavailable and have the potential to cause environmental impacts to marine ecosystems (Neff, 1990). However, the risk of toxic exposure in the water column is usually localized and short-lived because of the effects of evaporation and mixing processes in the water column (NRC, 1989).

Water solubility and temperature are the two main environmental conditions that affect dissolution. Dissolution preferentially depletes lightweight components with low boiling point hydrocarbons in a "ring" form (aromatic hydrocarbons) because of their greater solubility. Oil with greater concentrations of these aromatic hydrocarbons would more likely lose a higher percentage of its volume to dissolution.

B.5. NATURAL DISPERSION

Natural dispersion is the process of forming small oil droplets that become incorporated into the water column in the form of a dilute oil-in-water suspension. This process occurs when breaking waves mix the oil into the water column. Large droplets (more than 0.1 mm in diameter) are formed when mixing occurs and tend to concentrate near the water surface, while small droplets (less than 0.1 mm in diameter) break away from the main mass and become dispersed in the water column (Neff, 1990). Dispersion reduces the volume of the slick at the surface but does not change the physicochemical properties of the oil (CONCAWE, 1983).

Following evaporation, natural dispersion is the most important process in the breakup and disappearance of a slick. Based on spill observations, the percentage of oil lost from the remaining slick because of natural dispersion has been estimated to range from 10 to 60 percent per day for the first 3 days of the spill (CONCAWE, 1983). Dispersion begins soon after the oil is spilled onto the water surface, reaches a maximum rate approximately 10 hours after a spill, and may continue for several weeks. Dispersion overtakes spreading as the primary mechanism of transport of oil from the spill site within 100 hours following a spill (Neff, 1990).

Low-viscosity oils undergo dispersion more easily than high-viscosity oils, so as oil evaporates or weathers, viscosity increases and natural dispersion decreases. Since energy is required to mix the oil into the water column, winds generating breaking waves are the primary forces promoting dispersion. This is why higher sea states result in enhanced dispersion. In addition, slick thickness hinders natural dispersion, since oil cohesion is thickness dependent and makes oil breakup more difficult. In contrast, thinner slicks require less turbulence to be dispersed. Interfacial tension affects the oil's ability to break up into smaller droplets and its ability to recoalesce, so with a lower interfacial tension the oil is more likely to form oil droplets and natural dispersion is enhanced. Finally, many oils have naturally occurring surfactants that aid in the dispersion of the oil into the water column. These surfactants naturally align themselves in the oil to facilitate droplet formation and to prevent recoalescence (Neff, 1990).

B.6. EMULSIFICATION

Emulsification is the mixing of seawater droplets into oil spilled on the water's surface. As a surface slick undergoes evaporation, some of the heavier components tend to precipitate out of the oil mixture in the form of very fine, solid particles. These particles assist in stabilizing a water-in-oil emulsion because of the presence of natural surfactants. Emulsions typically contain 30 to 80 percent water, are highly viscous, and have a similar density to seawater (Mackay and McAuliffe, 1988). Emulsification can greatly increase the total volume of oil while inhibiting the natural weathering processes that act to reduce the spill volume. Emulsified oils often have a volume more than three times greater than the original volume of oil, become more viscous and sticky, resist being separated back into oil and water, and result in difficult cleanup and disposal issues for decision makers.

Over time, emulsions remaining in the water or stranded on the shoreline can result in the formation of tar lumps or patties, which are hard, weathered exteriors with gooey, slightly liquid centers. Emulsification often begins during the first day of the spill and can continue to occur throughout the first year. The largest volume of emulsion is typically formed within the first week of the spill, after loss of the lighter-weight components to evaporation and dissolution has occurred (Lee, 1980).

In general, viscous heavyweight oils tend to form stable water-in-oil emulsions that do not break down under the influence of standing, shearing, heating, or treating with chemicals. In contrast, less viscous oils produce weak emulsions that easily revert to oil residue and water, so emulsions are uncommon during refined oil spills. Emulsion formation is also more likely with oils containing natural surfactants. In addition, natural mixing energy is required to suspend the water into the oil for the formation of emulsions—the greater the mixing energy, the faster an emulsion will be formed and the greater the volume of water that can be incorporated into the emulsions. Emulsions are less likely to be formed under calm sea conditions (CONCAWE, 1983).

B.7. PHOTO-OXIDATION

Photo-oxidation is the process by which sunlight, in the presence of oxygen, transforms oil into new by-products. It occurs only at the surface of the oil slick, and by-products are usually removed and dissipate into the atmosphere and water column. Some of these by-products typically last only a few hours to a few days, as they are degraded by further photolytic action and are subject to dilution into the water column (Payne and McNabb, 1984). Other by-products are more toxic than the parent compounds; as a result, localized impacts to natural resources and the health of response personnel could occur (Mielke, 1990; Neff, 1990). Photo-oxidation also produces heavyweight by-products that are not soluble in oil or water (Neff, 1990). Photo-oxidation can begin within several hours following a spill and last for several weeks to a month.

Photo-oxidation plays a relatively minor role in the overall weathering of oil, as it is light-intensity dependent and is thus affected by the day-night cycle and cloud conditions (Mackay and McAuliffe, 1988). Photo-oxidation is also limited by weather conditions and the extent of emulsification. Rough sea states mix the oil into the water column, so as light intensity decreases with water depth, the rate of photo-oxidation will decrease as more of the oil is mixed into the water column. Photo-oxidation may also be limited for oil that has undergone extensive evaporation or that has become emulsified. In addition, the greater the surface area of the oil exposed to sunlight, the greater the effectiveness of photo-oxidation.

B.8. SEDIMENTATION AND SHORELINE STRANDING

Sedimentation is the incorporation of oil within suspended and bottom sediments, and it usually occurs with the heavier components of oil that do not dissolve in water. Sedimentation also occurs when marine organisms ingest naturally dispersed oil droplets and eliminate them as part of the fecal matter after passing undigested oil through their systems. Sedimentation can also occur when oil is stranded onshore, becomes incorporated with sediments, and is subsequently transported to subtidal environments. Shoreline stranding is the visible accumulation of petroleum along the shoreline following an oil spill. This stranded or beached oil can contribute to the volume of oil undergoing sedimentation as the stranded oil becomes sediment laden, sinks, or becomes buried along the shoreline. Sedimentation can begin almost immediately following a spill but increases and peaks several weeks into the spill. It is an important process in shallow, rough sea conditions where bottom sediments are repeatedly resuspended. In addition, sedimentation effectively removes oil from additional weathering processes, including natural biodegradation. As a result, the most persistent oil residues are usually those incorporated into subtidal sediments of estuarine or nearshore waters (Gundlach et al., 1983) or those stranded on low-energy shores (Hayes et al., 1993).

Water depth and physical energy affect the amount of suspended sediment in the water column, so shallow waters are likely to have higher concentrations of both suspended particles and microscopic organisms that can accelerate the sedimentation rate of oil. A high-energy, nearshore environment typically will have the necessary combination of suspended particles and wave action that lead to sedimentation. Low-energy areas are not likely to undergo sedimentation until after the oil has undergone extensive weathering. Wind, wave, and current patterns affect shoreline stranding of the oil. Onshore winds and storm events act to push surface slicks onshore, and wave action combined with tidal cycles can strand the oil on beaches until the next tidal cycle, when the oil is often lifted off intertidal sediments.

B.9. BIODEGRADATION

Biodegradation is the process by which naturally occurring bacteria and fungi consume hydrocarbons found in oil to use as a food source, and excrete carbon dioxide and water as waste products. It is a significant weathering process, albeit a slow one. Biodegradation occurs on the water surface, in the water column, in sediments, and onshore. Microbes that can utilize hydrocarbons are found naturally in marine habitats. After a spill occurs, they grow and multiply since additional food sources (carbon) become available following a spill.

For stranded oil, biodegradation becomes a dominant factor once physical processes reduce the toxic components of the oil (Fucey and Oudot, 1984). Biodegradation is the dominant weathering process for the light- and medium-weight components remaining after the other weathering processes have been greatly reduced. The biodegradation process can begin quickly following a spill and will continue as long as degradable hydrocarbons persist. Since the oil is initially toxic to microbes, there is a lag time between when the spill occurs and when the microbes begin to degrade the oil; this time period allows for removal of toxic components through other weathering processes (Hoff, 1992). Microbial degradation typically peaks within the first month after a spill as a result of the growth in the microbial population following the spill.

Current oil pollution conditions at a specific site determine the abundance of oil-degrading microbe populations and the biodegradation rates in the event of a spill. Biodegradation is water-temperature dependent, and is typically slower in cold and extremely hot environments (Lewis and Aurand, 1997). Nutrients in the water column can limit biodegradation when scarce, since microbes require nutrients for continued growth and reproduction. The majority of microbes live in aerobic environments since they require oxygen to biodegrade petroleum hydrocarbons. These microbes feed in areas where oxygen is normally plentiful (e.g., water column, water surface, and sediment surface). There are also microbes that degrade petroleum hydrocarbons in areas that lack oxygen but at a much slower rate. Oil in anaerobic environments may degrade very little, with oil persisting often for several years (Hoff, 1992). In general, oils and refined products that contain large quantities of heavyweight components may not undergo biodegradation, since the molecules are too large and complex for the microbes to degrade.

B.10. INTERACTION OF THE FATE AND TRANSPORT PROCESSES

To understand the complex interaction of the weathering processes described above, it is important to consider that these processes do not occur in isolation from one another, but rather simultaneously and in overlapping fashion through the course of an oil spill. In addition, these processes interact and affect each other in a complex web of feedbacks, and in turn affect the properties of the spilled oil (CONCAWE, 1983). The following is a limited list of some of the more common and important interactions between the weathering processes:

- Spreading enhances evaporation, dissolution, dispersion, emulsification, photo-oxidation, and biodegradation.
- Evaporated oil usually undergoes photo-oxidation in the atmosphere.
- Evaporation enhances emulsification of the slick, forming thick sludge and tar balls.
- Dissolved oil components in the water column undergo biodegradation or evaporation at the water surface.
- Natural dispersion reduces the volume of a slick on the surface, thus reducing evaporation.
- Natural dispersion exposes subsurface marine organisms to oil, and the oil may undergo sedimentation as a result of being consumed and reprocessed as fecal matter.
- Natural dispersion enhances biodegradation.
- Natural dispersion enhances sedimentation, as droplets bind to suspended sediments.
- Emulsification and thickening of the slick reduces the surface area of the spill, consequently reducing evaporation.
- Emulsification inhibits spreading, evaporation, and natural dispersion, and slows photo-oxidation and biodegradation.

This page intentionally left blank.

APPENDIX C
DISPERSANT AND *IN SITU* BURN PRE-AUTHORIZATION AGREEMENTS

C.1. Dispersant Pre-Authorization Agreements

All dispersant pre-authorization agreement tables are from the vessel response plan (VRP)/shipboard oil emergency plan (SOPEP) Web site[1].

Table C.1-1
Dispersant Pre-Authorization Agreements for National Response Team Region 1
Maine, Massachusetts, New Hampshire, Rhode Island, and Connecticut

Location	Pre-Authorization	Expedited Authorization	Trial Application	Restricted/Exclusion Areas	Special Consideration Areas
ME, NH	Waters at least ½ nm seaward of shoreline extending to the EEZ.	Waters within ½ nm seaward of shoreline. Concurrence of FOSC and SOSC(s).	N/A	N/A	• Isle of Shoals (NH Fish & Game). • ½ to 2 nm (DOI 1-hour consultation). • ½ to 2 nm from DOI-owned or -managed islands between January 1 and March 1, and May 1 and August 1 (DOI concurrence). • Jeffrey's Ledge between April 1 and September 30 (NMFS).
MA, RI	Waters under the jurisdiction of COTP Boston and COTP Providence seaward of 2 nm of the mainland or of designated islands extending to the EEZ. Water depth is greater than 40 ft.	N/A	N/A	N/A	• Jeffrey's Ledge between May 1 and September 30 (NMFS). • Stellwagen Bank between May 1 and November 15 (SBNMS Sanctuary Manager). • Great South Channel between May 1 and June 30, and October 1 and November 15 (NFMS). • Cape Cod Bay between February 1 and May 15.

[1] *http://www.uscg.mil/vrp/reg/disperse.shtml, page not dated*

Long Island Sound, CT	Waters under the jurisdiction of the COTP New York and/or COTP Long Island Sound at least 3 nm seaward of the Territorial Sea Baseline*. Waters along the coastline of NJ and/or the south shore of Long Island Sound, NY (north of the demarcation of the jurisdiction of COTP Philadelphia), west of a line from Montauk Point Light bearing 132° true to the outermost extent of the EEZ.	N/A	Waters as defined in the pre-authorization zone between ½–3 nm from the Territorial Sea Baseline. Trial application may also be conducted in the following water bodies: Hudson River south of the George Washington Bridge; Upper New York Bay; The Narrows; Lower New York Bay; Raritan Bay, excluding Spermaceti Cove and not within ½ nm of Sandy Hook, NJ; Arthur Kill; Newark Bay up to mouths of the Passaic and Hackensack Rivers; Kill Van Kull; East River south of Throgs Neck Bridge; Long Island Sound within COTP New York AOR only, excluding Little Bay, Little Neck Bay, Manhasset Bay, Hempstead Harbor, Eastchester Bay, and Pelham Bay, and not within ½ nm of the northern shore of Long Island.	Waters under jurisdiction of COTP New York and COTP Long Island Sound that lie within ½ nm of the Territorial Sea Baseline, including all bays and coves. Also includes the Hudson River north of the Tappan Zee Bridge and Long Island Sound, with the exception of the COTP New York AOR falling into the Trial Application Zone.	N/A

Note: nm, nautical mile; EEZ, U.S. Exclusive Economic Zone; FOSC, Federal On-Scene Coordinator; SOSC, State On-Scene Coordinator; DOI, U.S. Department of the Interior; NMFS, National Marine Fisheries Service; COTP, Captain of the Port; ft, feet; SBNMS, Stellwagen Bank National Marine Sanctuary; AOR, area of responsibility.

* As defined in 33 CFR 2.05–10.

Table C.1-2
Dispersant Pre-Authorization Agreements for National Response Team Region 2
New York and New Jersey

Pre-Authorization	Trial Application
Waters under the jurisdiction of COTP New York and COTP Long Island Sound at least 3 nm of the Territorial Sea Baseline* along the coast of NJ (north of the demarcation of the jurisdiction of COTP Philadelphia) and along the south shore of Long Island, NY, west of a line from Montauk Point Light bearing 132° true to the outermost extent of the EEZ. Including Ambrose Channel south of a line drawn between East Rockaway Inlet Breakwater Light and Sandy Hook Light and seaward of a line connecting the 10-m soundings off the coasts of NJ and NY.	Waters under the jurisdiction of COTP New York and COTP Long Island Sound that lie between ½ to 3 nm from the Territorial Sea Baseline. In addition, specific water bodies are also included in Zone 2 as follows: Hudson River south of George Washington Bridge; Upper New York Bay; The Narrows; Lower New York Bay; Raritan Bay, excluding Spermaceti Cove and not within ½ nm of Sandy Hook, NJ; Arthur Kill; Newark Bay up to mouths of the Passaic and Hackensack Rivers; Kill Van Kull; East River south of Throgs Neck Bridge; Long Island Sound within COTP New York AOR only, excluding Little Bay, Little Neck Bay, Manhasset Bay, Hempstead Harbor, Eastchester Bay, and Pelham Bay, and not within ½ nm of the northern shore of Long Island.

Note: COTP, Captain of the Port; nm, nautical mile; EEZ, U.S. Exclusive Economic Zone; AOR, area of responsibility.

* As defined in 33 CFR 2.05–10.

Table C.1-3
Dispersant Pre-Authorization Agreements for National Response Team Region 3
Delaware, Maryland, and Virginia

Pre-Authorization	Trial Application	Restricted/Exclusion Areas
Waters greater than 3 nm seaward of shoreline to the outermost extent of the EEZ.	Trial application may be conducted at distances ½ to 3 nm seaward of the shoreline or in depths greater than 40 ft, excluding bays and coves. Without concurrence, FOSC may authorize trial application on spills of only 50 bbl or less, or on portions 50 bbl or less of larger spills. Concurrence/non-concurrence decision is limited to within 4 hours after agency communication has been established.	Limited pre-authorization granted for trial use only on spills 50 bbl or less, or on portions 50 bbl or less of larger spills, on waters within Big Stone Beach Anchorage in the Delaware Bay area. Waters within ½ nm of shoreline. Water depth less than 40 ft. Limited to concurrence obtained within 4 hours after agency communication has been established.

Note: nm, nautical mile; EEZ, U.S. Exclusive Economic Zone; ft, feet; FOSC, Federal On-Scene Coordinator; bbl, barrels.

Table C.1-4
Dispersant Pre-Authorization Agreements for National Response Team Region 4
North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi

Pre-Authorization	Case-by-Case Authorization	Special Consideration Areas
Waters at least 3 nm seaward of shoreline extending to the EEZ. Water depth is at least 10 m.	Waters within 3 nm of shoreline. Water depth less than 10 m. Waters that under state or federal special management jurisdiction, including any waters designated as marine reserves, National Marine Sanctuaries, National or State Wildlife Refuges, units of the National Park Service, or proposed or designated critical habitats. Waters in mangrove and coastal wetland ecosystems (including submerged algal beds and submerged seagrass beds), or directly over living coral communities in waters less than 10 m deep.	Special Case for FL west coast: • State waters extend 9 nm seaward into the Gulf of Mexico. • No case-by-case authorization will be required or considered necessary from USEPA, DOI, DOC, or FL for waters greater than 10 m in depth that extend more than 3 nm seaward of FL west coast unless designated as meeting case-by-case criteria.

Note: nm, nautical mile; EEZ, U.S. Exclusive Economic Zone; m, meters; USEPA, U.S. Environmental Protection Agency; DOI, U.S. Department of the Interior; DOC, U.S. Department of Commerce.

Table C.1-5
Dispersant Pre-Authorization Agreements for Caribbean National Response Team
Puerto Rico and U.S. Virgin Islands

Location	Pre-Authorization	Case-by-Case Authorization	Restricted/Exclusion Areas	Special Considerations
PR	Waters at least ½ nm seaward of any shoreline extending to the EEZ. Water depth at least 60 ft.	Waters within ½ nm of the shoreline. Water depth less than 60 ft. Waters designated as marine reserves, National Marine Sanctuaries, National or State Wildlife Refuges, or proposed or designated critical habitats. Waters in mangroves or coastal wetland ecosystems (including submerged algal beds and submerged seagrass beds), or directly over coral communities in waters less than 60 ft.	N/A	N/A
USVI	Waters at least 1 nm seaward of any shoreline extending to the EEZ. Water depth at least 60 ft.	Waters within 1 nm of the shoreline. Water depth less than 60 ft. Waters designated as marine reserves, National Marine Sanctuaries, National or State Wildlife Refuges, or proposed or designated critical habitats. Waters in mangroves or coastal wetland ecosystems (including submerged algal beds and submerged seagrass beds), or directly over coral communities in waters less than 60 ft.	Waters of the Virgin Islands National Park, including waters 1 nm seaward of the park boundary*. Waters of the Buck Island Reef National Monument including waters 1 nm seaward from the park boundary*.	* Dispersants may be applied to a restricted area in the event that: • Dispersant application is necessary to prevent or substantially reduce a hazard to human life. • An emergency modification of this agreement is made on an incident-specific basis.

Note: nm, nautical mile; EEZ, U.S. Exclusive Economic Zone; ft, feet.

Table C.1-6
Dispersant Pre-Authorization Agreements for National Response Team Region 6
Texas and Louisiana

Pre-Authorization	Special Considerations
Waters more than 3 nm seaward of shoreline, or water depth greater than 10 m, whichever is farthest from shore, extending to the EEZ.	All dispersant spray operations are conducted during daylight hours only. In the Flower Gardens National Marine Sanctuary: • Decision to apply dispersants must be based on the weather, sea state, water temperature, oil characteristics, history of spill, and risk of spill contact for particular life forms. • All efforts must be made to apply them in water as deep as possible and as far from the Sanctuary as possible.

Note: nm, nautical mile; m, meters; EEZ, U.S. Exclusive Economic Zone.

Table C.1-7
Dispersant Pre-Authorization Agreements for National Response Team Region 9
California

Location	Pre-Authorization	Case-by-Case Authorization/ RRT Approval Required	Special Considerations
North Coast Region (CA–OR border to the southern edge of Sonoma County)	All federal waters off the North Coast Region 3 to 200 nm seaward.	N/A	N/A
San Diego Area	All federal waters 3 to 200 nm seaward within the COTP San Diego AOR, excluding an area 3 nm from the U.S.–Mexico border.	Federal waters of the CINMS, including those waters 3 nm seaward of the baseline to the CINMS outer boundary at 6 nm from the islands. All remaining federal waters within COTP San Diego AOR not covered by the above zones remain under the current Quick Approval Process and are designated RRT Approval Required zones.	Pre-authorization criteria does not apply to Group I oils (gasoline, diesel, and jet fuels).
San Francisco, Central Coast (Santa Cruz and Monterey Counties), and San Francisco Bay and Delta	All federal waters 3 to 200 nm within the Central Coast Region and the San Francisco Bay and Delta AOR. All federal waters 6 to 200 nm seaward of the MBNMS.	Federal waters of the Gulf of the Farallones, Cordell Bank, and the portion of the MBNMS within the San Francisco Bay and Delta AOR are designated as RRT Approval Required zones. All remaining waters within the San Francisco Bay and Delta AOR not covered by the above zones remain under the current Quick Approval Process and are designated RRT Approval Required zones.	N/A
Los Angeles-Long Beach	All federal waters 3 to 200 nm within the COTP Los Angeles.	The federal waters of the MBNMS within the COTP Los Angeles and up to 3 nm beyond the MBNMS as RRT Approval Required zones. The federal waters of the CINMS as RRT Approval Required zone, including those waters from 3 nm seaward of the baseline to the CINMS outer boundary at 6 nm from the islands. All remaining waters within AOR not covered by the above zones remain under the current Quick Approval Process and are designated RRT Approval Required zones.	N/A

Note: nm, nautical mile; COTP, Captain of the Port; AOR, area of responsibility; m, meters; CINMS, Channel Islands National Marine Sanctuary; RRT, Regional Response Team; MBNMS, Monterey Bay National Marine Sanctuary.

Table C.1-8
Dispersant Pre-Authorization Agreements for National Response Team Region 10
Washington, Oregon, and Alaska

Location	Pre-Authorization	Case-by-Case Authorization	Restricted/Exclusion Areas	Special Consideration Areas
WA, OR	N/A	All requests for dispersant application in WA and OR are subject to review on a case-by-case basis.	N/A	N/A
AK	Refer to the X. Northwest Alaska link on the VRP/SOPEP Web site*.	Refer to the X. Northwest Alaska link on the VRP/SOPEP Web site*.	Dispersant use is not recommended in the following zones: • Upper Cook Inlet: Inshore of the 5-fathom isobath, during the first 3 hours of an ebb tide, and for all periods outside of that, an area north of a line extending from Point Possession to the North Forelands. • Middle Cook Inlet: Inshore of the 5-fathom isobath near the northeast shoreline and inshore of the 10-fathom isobath along the southeast and west shorelines. • Lower Cook Inlet: Inshore of 10-fathom isobath along the east and west shorelines, inshore of 5-fathom isobath around Kalgin Island, and inshore of a 1-mi buffer along the extreme southern portions of Cook Inlet, where 10-fathom isobath drops off rapidly near shore. • Port of Valdez and Valdez Arm: Tatitlek Narrows and Columbia Bay. • Main body of Prince William Sound: The majority of the waters in this section, with the exception of tanker lanes and an appropriate buffer zone to either side of these lanes. • Hinchinbrook Entrance: The area around Seal Rocks. • Copper River Delta: Inshore of the 3-mi territorial limit along the coast from Cape Hinchinbrook to Kayak Island. • Montague Island: Inshore of a line drawn approximately 1 nm off the outside coasts of Montague and Elrington Islands and extending east to Cape Junken.	• Cook Inlet: Because of the large numbers of commercially valuable adult salmon, the section of Cook Inlet north of a line drawn along the latitude at Anchor Point north of Kachemak Bay is considered case by case from July 1 to August 15. • Prince William Sound: Tanker lanes have a pre-authorization designation, while most of the remaining area is case by case. Refer to the X. Northwest Alaska link on the VRP/SOPEP Web site* for more in-depth guidelines concerning Cook Inlet and Prince William Sound.

Note: mi, mile; nm, nautical mile.

* *http://www.uscg.mil/vrp/maps/dispmap.shtml*, last updated August 19, 2004

Table C.1-9
Dispersant Pre-Authorization Agreements for National Response Team Oceania Region
Hawaii, Guam, Commonwealth of Northern Mariana Islands, and American Samoa

Location	Pre-Authorization	Case-by-Case Authorization
HI	Water depths greater than 10 fathoms, with the exception of the Maui County four-island area bounded by La'au Point, Molokai to Kaena Point, Lanai; Kamaiki Point, Lanai to Cape Kuikui, Kahoolawe; Cape Kuikui, Kahoolawe to Cape Hanamanioa, Maui; and Lipoa Point, Maui to Cape Halawa, Molokai.	In any case where circumstances do not meet the guidelines, use of dispersants is subject to case-by-case authorization.
Guam, CNMI	N/A	N/A
American Samoa	N/A	Any applications of dispersants within the American Samoa AOR must be authorized by the Oceania RRT.

Note: AOR, area of responsibility; RRT, Regional Response Team.

C.2. *IN SITU* BURN PRE-AUTHORIZATION AGREEMENTS

All *in situ* burn pre-authorization agreement tables are from Ellis (2004)[2].

Table C.2-1
***In Situ* Burn Pre-Authorization Agreements for National Response Team Region 1**
Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut

	A Zone	B Zone	C Zone
Location of Burn	Waters located seaward of a point 6 nm from the mean low waterline along the coasts and islands of ME, NH, MA, and RI.	Waters located seaward of a line measured 1 nm and terminating 6 nm from the mean low water line along the coasts and islands of ME, MA, NH, and RI.	Waters shoreward of a line measured 1 nm seaward of the mean low water mark along the coasts and islands of ME, MA, NH, and RI.
Authorization/Consultation	Decision to burn rests solely with the FOSC.	Decision to burn rests solely with FOSC and SOSC within the Unified Command.	Decision to burn rests solely with FOSC and SOSC. FOSC must consult with NOAA and DOI on appropriateness of *in situ* burning as a removal action.
Extenuating Circumstances	Presence of threatened or endangered species within the intended burn area requires consultation with trustee agency prior to initiating burn operations. Consultation with the appropriate officials must occur when lands belonging to Canada, other states, and Region II may fall within 6 nm of the burn source.		
Special Consideration Areas	• ME SCA: FOSC shall gain concurrence of ME SOSC for *in situ* burns within 12 nm of the state coast. • 20-ft water depth SCA: FOSC must consult with DOI and NOAA RRT representatives in areas where water depth is less than 20 ft at mean low water. Applies to areas outside of C Zone as well. • NMFS SCA: Case-by-case consultation with NMFS Northeast Region is required for the following locations: – Jeffrey's Ledge (April 1 to September 30) – Great South Channel (April 1 to June 30, October 1 to November 15) – Cape Cod Bay (February 1 to May 15) • NOS SCA: Case-by-case consultation with sanctuary manager is required for SBNMS (year-round)		

Note: nm, nautical mile; FOSC, Federal On-Scene Coordinator; SOSC, State On-Scene Coordinator; NOAA, National Oceanic and Atmospheric Administration; DOI, U.S. Department of the Interior; SCA, Special Consideration Area; RRT, Regional Response Team; ft, feet; NMFS, National Marine Fisheries Service; NOS, National Ocean Service; SBNMS, Stellwagen Bank National Marine Sanctuary.

[2] Personal communication from LT Sarah Ellis, Office of Response, U.S. Coast Guard Headquarters, 2100 Second Street, S.W., Washington, D.C., December 2004.

Table C.2-2
***In Situ* Burn Pre-Authorization Agreements for National Response Team Region 2**
New York and New Jersey

	A Zone	B Zone	C Zone	E Zone
Location of Burn	Waters that lie 6 nm and seaward of the Territorial Sea Baseline* along the coast of NJ and along the south shore of Long Island, NY.	Waters that lie between 3 nm and 6 nm from the Territorial Sea Baseline.	Waters that (1) lie within state territorial boundaries; (2) are not included in A, B, or E Zones; (3) are designated as marine reserves, National Marine Sanctuaries, National or State Wildlife Refuges, units of the National Park Service, or proposed or designated Critical Habitats; or (4) are considered coastal wetlands, including submerged algal beds and submerged seagrass beds.	No *in situ* burning will occur in an E Zone unless (1) there exists a clear, immediate, and extreme risk to human health or safety; or (2) an emergency modification of the MOU is made on an incident-specific basis.
Authorization/Consultation	Decision to burn rests solely with FOSC.	Decision to burn rests solely with FOSC if and only if prevailing winds are in a seaward direction and are expected to remain in a seaward direction for duration of burn operations.	Request by FOSC to conduct *in situ* burning must be submitted to the USEPA, USCG, NOAA, DOI, and the states of NY and/or NJ, along with information specified in Appendix II of the RRT II ISB MOU.	No E Zones have been pre-identified.
Extenuating Circumstances	Presence of threatened or endangered species within the intended burn area requires consultation with trustee agency prior to initiating burn operations.			

Note: nm, nautical mile; MOU, Memorandum of Understanding; FOSC, Federal On-Scene Coordinator; USEPA, U.S. Environmental Protection Agency; USCG, U.S. Coast Guard; NOAA, National Oceanic and Atmospheric Administration; DOI, U.S. Department of the Interior; RRT, Regional Response Team; ISB, *in situ* burning.

* As defined in 33 CFR 2.05–10.

Table C.2-3
***In Situ* Burn Pre-Authorization Agreements for National Response Team Region 3**
Delaware, Maryland, and Virginia

	A Zone	B Zone	R Zone
Location of Burn	Waters that lie 3 nm and seaward of the Territorial Sea Baseline* along the coasts of DE, MD, and VA.	Waters that (1) lie within state territorial boundaries; (2) are not included in A or R Zones; (3) are designated as marine reserves, National Marine Sanctuaries, National or State Wildlife Refuges, units of the National Park Service, or proposed or designated Critical Habitats; or (4) are considered coastal wetlands, including submerged algal beds and submerged seagrass beds.	Waters falling under the jurisdiction of RRT III that are not classified as A or B Zones.
Authorization/Consultation	Decision to burn rests solely with the FOSC, provided the requirements listed under the Protocols section of the RRT III ISB MOU are followed.	Request by FOSC to conduct *in situ* burning must be submitted to the RRT, along with the information specified in Appendix II of RRT III ISB MOU.	No *in situ* burning will occur in an R Zone unless (1) there exists a clear, immediate, and extreme risk to human health or safety; or (2) an emergency modification of the MOU is made on an incident-specific basis.

Note: nm, nautical mile; RRT, Regional Response Team; FOSC, Federal On-Scene Coordinator; RRT, Regional Response Team; ISB, *in situ* burning; MOU, Memorandum of Understanding.

* As defined in 33 CFR 2.05–10.

Table C.2-4
***In Situ* Burn Pre-Authorization Agreements for National Response Team Region 4**
North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi

	A Zone	B Zone	R Zone
Location of Burn	Waters at least 3 nm seaward from any state coastline and seaward of any state waters, or as designated by separate LOA, with each individual state, USEPA, USCG, DOI, and DOC. In the event that state jurisdiction extends beyond 3 nm from a state shoreline, pre-authorization for the A Zone applies only to those areas outside state jurisdiction unless a LOA is in place for those waters.	Waters falling under state or special management jurisdiction that are (1) anywhere within state waters; (2) not included in A or R Zones; (3) waters less than 30 ft in depth that contain living reefs; (4) waters designated as marine reserves, National Marine Sanctuary, National or State Wildlife Refuge, unit of the National Park Service, proposed or designated Critical Habitats; and (5) mangrove areas or coastal wetlands, which include submerged algal beds and submerged seagrass beds.	Waters falling under state or special management jurisdiction that are not included in A or B Zones.
Authorization/Consultation	Decision to burn rests solely with FOSC.	Request by FOSC to conduct *in situ* burning must be submitted to the RRT and the affected state(s), along with the required information listed in Appendix VI of the MOU. If RRT has not responded within 4 hours, FOSC may conduct *in situ* burning.	No *in situ* burning will occur in an R Zone unless (1) there exists a clear, immediate, and extreme risk to human health or safety, or (2) an emergency modification of the MOU is made on an incident-specific basis.
Special Case for the West Coast of Florida	FL state waters extend 9 nm into the Gulf of Mexico, whereas all other state coastal waters, unlike other state waters, which extend to only 3 nm. However, case-by-case authorization shall be necessary only for waters within 3 nm of the west coast of FL, and no further.		

Note: nm, nautical mile; LOA, Letter of Agreement; USEPA, U.S. Environmental Protection Agency; USCG, U.S. Coast Guard; DOI, U.S. Department of the Interior; DOC, U.S. Department of Commerce; ft, feet; FOSC, Federal On-Scene Coordinator; RRT, Regional Response Team; MOU, Memorandum of Understanding.

Table C.2-5
In Situ Burn Pre-Authorization Agreements for National Response Team Region 6 Louisiana and Texas

	Pre-Authorized Zone
Location of Burn	Waters at least 3 nm offshore.
Authorization/Consultation	Decision to burn rests solely with FOSC.
Exclusion Zone	Natural banks, hard bottom areas, artificial reefs, and shoals. Refer to Appendix E of the RRT IV ISB Plan for specific locations.
Extenuating Circumstances	In the event of a southerly or generally onshore wind existing, the buffer zone for Grand Isle, LA, extends to 7 nm from the center of town.

Note: nm, nautical mile; FOSC, Federal On-Scene Coordinator; RRT, Regional Response Team; ISB, *in situ* burning.

Table C.2-6
In Situ Burn Pre-Authorization Agreements for National Response Team Region 9 California

	Pre-Authorized Zone	Case-by-Case Zone
Location of Burn	35 to 200 nm off the CA coast.	0 to 35 nm off the CA coast, state waters.
Authorization/Consultation	Decision to burn rests solely with the FOSC.	If within 0 to 35 nm, consultation with the state representative to RRT IX is required. If within state waters, concurrence of the state representative is required.
Extenuating Circumstances	If pre-authorization conditions are not met, selected representatives in RRT IX must be involved prior to commencing with any *in situ* burn.	

Note: nm, nautical mile; FOSC, Federal On-Scene Coordinator; RRT, Regional Response Team.

Table C.2-7
***In Situ* Burn Pre-Authorization Agreements for National Response Team Region 10**
Washington, Oregon, and Alaska

	Pre-Authorized Zone	Case-by Case Zone
Washington and Oregon		
Location of Burn	Areas more than 3 nm from population.	All other areas.
Authorization/Consultation	Decision to burn rests solely with the Unified Command.	
Alaska		
Authorization/Consultation	A trial burn will be conducted prior to initiating *in situ* burn operations. Based on results of the trial burn, decisions to continue authorization or prohibit/limit future *in situ* burning will be decided by FOSC and SOSC(s).	

Note: nm, nautical mile; FOSC, Federal On-Scene Coordinator; SOSC, State On-Scene Coordinator.

Table C.2-8
***In Situ* Burn Pre-Authorization Agreements for National Response Team Oceania Region**
Hawaii, Guam, Commonwealth of Northern Mariana Islands, and American Samoa

	Pre-Authorized Zone
Hawaii	
Location of Burn	Waters off the HI coast.
Authorization/Consultation	Decision to burn rests solely with FOSC.
Extenuating Circumstances	• Winds are blowing offshore; or • If winds are variable or blowing onshore, potential plume will not expose human populations to more than 150 μg/m^3 of particulate less than 10 microns in diameter averaged over an 1-hour period as determined by the OSC; and • Plume or heat from the burn will not result in greater impact to sensitive wildlife resources than would the spilled oil.
Guam, Commonwealth of Northern Mariana Islands, and American Samoa	
Authorization/Consultation	There is no pre-authorized *in situ* burning within these COTP areas. FOSC must go through the RRT for approval of any *in situ* burning.

Note: FOSC, Federal On-Scene Coordinator; COTP, Captain of the Port; RRT, Regional Response Team.

APPENDIX D
CALCULATED EFFICIENCY RATES FOR MECHANICAL RECOVERY, *IN SITU* BURN, AND DISPERSANT RESPONSE TECHNOLOGIES

D.1. DATA DESCRIPTION—GENERAL

To effectively model the potential impacts and benefits for each proposed alternative, certain assumptions were made regarding how effective each response option[1] would be in producing its intended benefit. In short, the model requires the following inputs for both the 2,500- and 40,000-barrel (bbl) spill scenarios[2] used:

- **Mechanical recovery (Tables D.2-1 through D.2-4)—**The volume of spilled oil that would be recovered from the water using booms, skimmers, and storage devices on an hourly basis over the first 96 hours of the spill response.
- ***In situ* burning (Tables D.3-1 through D.3-4)—**The volume of spilled oil that would be contained in fire-resistant boom and burned in place, on water, on an hourly basis over the first 60 hours of the spill response, which is the end of the *in situ* burn operating period contained in the proposed regulation.
- **Chemical dispersion in Gulf of Mexico region (Tables D.4-1 through D.4-8)—**In Gulf waters the regulation proposes that a larger quantity of dispersant be available in the first operational period than is proposed in non–Gulf waters. Hence, data is needed about the amount of oil that would be removed from the water surface and dispersed into the water column on an hourly basis over the first 60 hours of the spill, which is the end of the dispersant application operating period contained in the proposed regulation.

[1] The response options analyzed and discussed in this Programmatic Environmental Impact Statement (PEIS)—mechanical recovery, *in situ* burning, and chemical dispersion—are for on-water recovery.
[2] For a detailed discussion on why these spill scenarios were chosen, see Chapter 4.

- **Chemical dispersion in non–Gulf of Mexico regions (Tables D.4-9 through D.4-16)—** In non–Gulf waters the regulation proposes a lesser quantity of dispersant be available in the first operational period than is proposed in Gulf waters. Hence, data is needed about the amount of oil that would be removed from the water surface and dispersed into the water column on an hourly basis over the first 60 hours of the spill, which is the end of the dispersant application operating period contained in the proposed regulation.

More detailed assumptions regarding all mechanical recovery, *in situ* burning, and chemical dispersion tables include the following:

- The purpose of these tables is to provide hourly estimates of all recovery activity over the course of the response period for use in the Applied Science Associates (ASA) spill model SIMAP.
- Tables were prepared for spills occurring at midnight (0000), 6 A.M. (0600), noon (1200), and 6 P.M. (1800) to account for variations in effectiveness caused by delays in initiation of response. Response operations are not conducted during darkness because of personnel safety considerations.
- Daylight is assumed to be from 6 A.M. to 6 P.M. No cleanup operations will be conducted during hours of darkness.
- It was assumed that mechanical recovery would commence 12 hours after the spill or at first light after hour 12.
- It was assumed that first dispersant application would occur 7 hours after the spill occurred or at first light after hour 7.
- Assumed oil is Group II/III medium crude with characteristics that make it amenable to mechanical recovery, *in situ* burning, and chemical dispersion.
- Based on 33 CFR 155, Appendix B, Table 3, 40 percent of natural dissipation will be assumed to occur prior to commencing response operations. The model runs will rely on computer-generated, hourly natural dissipation estimates related to the specific oils used in the scenarios.
- Changes in oil mass from emulsification are not estimated. Emulsification will be estimated in the computer models along with all the other natural dissipation effects.
- Based on 33 CFR 155, Appendix B, Table 3, 48 hours of daylight will be assumed over the 4-day response period (96 hours).

D.2. DATA DESCRIPTION—MECHANICAL RECOVERY (TABLES D.2-1 THROUGH D.2-4)

- All estimates are in barrels.
- Mechanical recovery operations will continue to hour 96 after the start of the spill.
- Assumed areas are higher-volume port response areas, which require mechanical recovery to start at hour 12 rather than hour 24.

- Tier 1, hours 12 to 36
- Tier 2, hours 36 to 60
- Tier 3, hours 60 to 96

• Effectiveness calculator relies on nearshore estimates contained in 33 CFR 155, Appendix B, Table 3, which suggests natural dissipation and mechanical recovery rates.

- Response will last 4 days.
- Natural dissipation will be 40 percent (average of evaporation rates for light and medium crude oils).
- Hourly mechanical recovery rate will be 50 percent of the total oil available on the water at the beginning of that hour divided by 48 (the total number of cleanup hours in the 4-day response).

Table D.2-1
Mechanical Recovery of 2,500- and 40,000-bbl Spills, Midnight (0000)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
0–6	0	1,500	0	24,000
7	16	1,484	250	23,750
8	15	1,469	247	23,503
9	15	1,454	245	23,258
10	15	1,438	242	23,016
11	15	1,423	240	22,776
12	15	1,409	237	22,539
13	15	1,394	235	22,304
14	15	1,379	232	22,071
15	14	1,365	230	21,842
16	14	1,351	228	21,614
17	14	1,337	225	21,389
18	14	1,323	223	21,166
19	0	1,323	0	21,166
20	0	1,323	0	21,166
21	0	1,323	0	21,166
22	0	1,323	0	21,166
23	0	1,323	0	21,166
24	0	1,323	0	21,166
25	0	1,323	0	21,166
26	0	1,323	0	21,166
27	0	1,323	0	21,166
28	0	1,323	0	21,166
29	0	1,323	0	21,166
30	0	1,323	0	21,166

continued

Table D.2-1 (*continued*)
Mechanical Recovery of 2,500- and 40,000-bbl Spills, Midnight (0000)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
31	14	1,309	220	20,946
32	14	1,295	218	20,727
33	13	1,282	216	20,511
34	13	1,269	214	20,298
35	13	1,255	211	20,086
36	13	1,242	209	19,877
37	13	1,229	207	19,670
38	13	1,217	205	19,465
39	13	1,204	203	19,262
40	13	1,191	201	19,062
41	12	1,179	199	18,863
42	12	1,167	196	18,667
43	0	1,167	0	18,667
44	0	1,167	0	18,667
45	0	1,167	0	18,667
46	0	1,167	0	18,667
47	0	1,167	0	18,667
48	0	1,167	0	18,667
49	0	1,167	0	18,667
50	0	1,167	0	18,667
51	0	1,167	0	18,667
52	0	1,167	0	18,667
53	0	1,167	0	18,667
54	0	1,167	0	18,667
55	12	1,155	194	18,472
56	12	1,142	192	18,280
57	12	1,131	190	18,089
58	12	1,119	188	17,901
59	12	1,107	186	17,715
60	12	1,096	185	17,530
61	11	1,084	183	17,347
62	11	1,073	181	17,167
63	11	1,062	179	16,988
64	11	1,051	177	16,811
65	11	1,040	175	16,636
66	11	1,029	173	16,463
67	0	1,029	0	16,463
68	0	1,029	0	16,463
69	0	1,029	0	16,463
70	0	1,029	0	16,463

continued

Table D.2-1 (*continued*)
Mechanical Recovery of 2,500- and 40,000-bbl Spills, Midnight (0000)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
71	0	1,029	0	16,463
72	0	1,029	0	16,463
73	0	1,029	0	16,463
74	0	1,029	0	16,463
75	0	1,029	0	16,463
76	0	1,029	0	16,463
77	0	1,029	0	16,463
78	0	1,029	0	16,463
79	11	1,018	171	16,291
80	11	1,008	170	16,121
81	10	997	168	15,953
82	10	987	166	15,787
83	10	976	164	15,623
84	10	966	163	15,460
85	10	956	161	15,299
86	10	946	159	15,140
87	10	936	158	14,982
88	10	927	156	14,826
89	10	917	154	14,671
90	10	907	153	14,519
91	0	907	0	14,519
92	0	907	0	14,519
93	0	907	0	14,519
94	0	907	0	14,519
95	0	907	0	14,519
96	0	907	0	14,519

* 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.
† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.
‡ Shaded cells denote nighttime hours.

Table D.2-2
Mechanical Recovery of 2,500- and 40,000-bbl Spills, 6 A.M. (0600)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
0–6	0	1,500	0	24,000
7	0	1,500	0	24,000
8	0	1,500	0	24,000
9	0	1,500	0	24,000
10	0	1,500	0	24,000

continued

Table D.2-2 (*continued*)
Mechanical Recovery of 2,500- and 40,000-bbl Spills, 6 A.M. (0600)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
11	0	1,500	0	24,000
12	0	1,500	0	24,000
13	0	1,500	0	24,000
14	0	1,500	0	24,000
15	0	1,500	0	24,000
16	0	1,500	0	24,000
17	0	1,500	0	24,000
18	0	1,500	0	24,000
19	0	1,500	0	24,000
20	0	1,500	0	24,000
21	0	1,500	0	24,000
22	0	1,500	0	24,000
23	0	1,500	0	24,000
24	0	1,500	0	24,000
25	16	1,484	250	23,750
26	15	1,469	247	23,503
27	15	1,454	245	23,258
28	15	1,438	242	23,016
29	15	1,423	240	22,776
30	15	1,409	237	22,539
31	15	1,394	235	22,304
32	15	1,379	232	22,071
33	14	1,365	230	21,842
34	14	1,351	228	21,614
35	14	1,337	225	21,389
36	14	1,323	223	21,166
37	0	1,323	0	21,166
38	0	1,323	0	21,166
39	0	1,323	0	21,166
40	0	1,323	0	21,166
41	0	1,323	0	21,166
42	0	1,323	0	21,166
43	0	1,323	0	21,166
44	0	1,323	0	21,166
45	0	1,323	0	21,166
46	0	1,323	0	21,166
47	0	1,323	0	21,166
48	0	1,323	0	21,166

continued

Table D.2-2 (*continued*)
Mechanical Recovery of 2,500- and 40,000-bbl Spills, 6 A.M. (0600)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
49	14	1,309	220	20,946
50	14	1,295	218	20,727
51	13	1,282	216	20,511
52	13	1,269	214	20,298
53	13	1,255	211	20,086
54	13	1,242	209	19,877
55	13	1,229	207	19,670
56	13	1,217	205	19,465
57	13	1,204	203	19,262
58	13	1,191	201	19,062
59	12	1,179	199	18,863
60	12	1,167	196	18,667
61	0	1,167	0	18,667
62	0	1,167	0	18,667
63	0	1,167	0	18,667
64	0	1,167	0	18,667
65	0	1,167	0	18,667
66	0	1,167	0	18,667
67	0	1,167	0	18,667
68	0	1,167	0	18,667
69	0	1,167	0	18,667
70	0	1,167	0	18,667
71	0	1,167	0	18,667
72	0	1,167	0	18,667
73	12	1,155	194	18,472
74	12	1,142	192	18,280
75	12	1,131	190	18,089
76	12	1,119	188	17,901
77	12	1,107	186	17,715
78	12	1,096	185	17,530
79	11	1,084	183	17,347
80	11	1,073	181	17,167
81	11	1,062	179	16,988
82	11	1,051	177	16,811
83	11	1,040	175	16,636
84	11	1,029	173	16,463

continued

Table D.2-2 (*continued*)
Mechanical Recovery of 2,500- and 40,000-bbl Spills, 6 A.M. (0600)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
85	0	1,029	0	16,463
86	0	1,029	0	16,463
87	0	1,029	0	16,463
88	0	1,029	0	16,463
89	0	1,029	0	16,463
90	0	1,029	0	16,463
91	0	1,029	0	16,463
92	0	1,029	0	16,463
93	0	1,029	0	16,463
94	0	1,029	0	16,463
95	0	1,029	0	16,463
96	0	1,029	0	16,463

* 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

‡ Shaded cells denote nighttime hours.

Table D.2-3
Mechanical Recovery of 2,500- and 40,000-bbl Spills, Noon (1200)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
0–6	0	1,500	0	24,000
7	0	1,500	0	24,000
8	0	1,500	0	24,000
9	0	1,500	0	24,000
10	0	1,500	0	24,000
11	0	1,500	0	24,000
12	0	1,500	0	24,000
13	0	1,500	0	24,000
14	0	1,500	0	24,000
15	0	1,500	0	24,000
16	0	1,500	0	24,000
17	0	1,500	0	24,000
18	0	1,500	0	24,000
19	16	1,484	250	23,750
20	15	1,469	247	23,503
21	15	1,454	245	23,258
22	15	1,438	242	23,016
23	15	1,423	240	22,776

continued

Table D.2-3 (*continued*)
Mechanical Recovery of 2,500- and 40,000-bbl Spills, Noon (1200)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
24	15	1,409	237	22,539
25	15	1,394	235	22,304
26	15	1,379	232	22,071
27	14	1,365	230	21,842
28	14	1,351	228	21,614
29	14	1,337	225	21,389
30	14	1,323	223	21,166
31	0	1,323	0	21,166
32	0	1,323	0	21,166
33	0	1,323	0	21,166
34	0	1,323	0	21,166
35	0	1,323	0	21,166
36	0	1,323	0	21,166
37	0	1,323	0	21,166
38	0	1,323	0	21,166
39	0	1,323	0	21,166
40	0	1,323	0	21,166
41	0	1,323	0	21,166
42	0	1,323	0	21,166
43	14	1,309	220	20,946
44	14	1,295	218	20,727
45	13	1,282	216	20,511
46	13	1,269	214	20,298
47	13	1,255	211	20,086
48	13	1,242	209	19,877
49	13	1,229	207	19,670
50	13	1,217	205	19,465
51	13	1,204	203	19,262
52	13	1,191	201	19,062
53	12	1,179	199	18,863
54	12	1,167	196	18,667
55	0	1,167	0	18,667
56	0	1,167	0	18,667
57	0	1,167	0	18,667
58	0	1,167	0	18,667
59	0	1,167	0	18,667
60	0	1,167	0	18,667
61	0	1,167	0	18,667
62	0	1,167	0	18,667
63	0	1,167	0	18,667
64	0	1,167	0	18,667

continued

Table D.2-3 (*continued*)
Mechanical Recovery of 2,500- and 40,000-bbl Spills, Noon (1200)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
65	0	1,167	0	18,667
66	0	1,167	0	18,667
67	12	1,155	194	18,472
68	12	1,142	192	18,280
69	12	1,131	190	18,089
70	12	1,119	188	17,901
71	12	1,107	186	17,715
72	12	1,096	185	17,530
73	11	1,084	183	17,347
74	11	1,073	181	17,167
75	11	1,062	179	16,988
76	11	1,051	177	16,811
77	11	1,040	175	16,636
78	11	1,029	173	16,463
79	0	1,029	0	16,463
80	0	1,029	0	16,463
81	0	1,029	0	16,463
82	0	1,029	0	16,463
83	0	1,029	0	16,463
84	0	1,029	0	16,463
85	0	1,029	0	16,463
86	0	1,029	0	16,463
87	0	1,029	0	16,463
88	0	1,029	0	16,463
89	0	1,029	0	16,463
90	0	1,029	0	16,463
91	11	1,018	171	16,291
92	11	1,008	170	16,121
93	10	997	168	15,953
94	10	987	166	15,787
95	10	976	164	15,623
96	10	966	163	15,460

* 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

‡ Shaded cells denote nighttime hours.

Table D.2-4
Mechanical Recovery of 2,500- and 40,000-bbl Spills, 6 P.M. (1800)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
0–6	0	1,500	0	24,000
7	0	1,500	0	24,000
8	0	1,500	0	24,000
9	0	1,500	0	24,000
10	0	1,500	0	24,000
11	0	1,500	0	24,000
12	0	1,500	0	24,000
13	16	1,484	250	23,750
14	15	1,469	247	23,503
15	15	1,454	245	23,258
16	15	1,438	242	23,016
17	15	1,423	240	22,776
18	15	1,409	237	22,539
19	15	1,394	235	22,304
20	15	1,379	232	22,071
21	14	1,365	230	21,842
22	14	1,351	228	21,614
23	14	1,337	225	21,389
24	14	1,323	223	21,166
25	0	1,323	0	21,166
26	0	1,323	0	21,166
27	0	1,323	0	21,166
28	0	1,323	0	21,166
29	0	1,323	0	21,166
30	0	1,323	0	21,166
31	0	1,323	0	21,166
32	0	1,323	0	21,166
33	0	1,323	0	21,166
34	0	1,323	0	21,166
35	0	1,323	0	21,166
36	0	1,323	0	21,166
37	14	1,309	220	20,946
38	14	1,295	218	20,727
39	13	1,282	216	20,511
40	13	1,269	214	20,298
41	13	1,255	211	20,086
42	13	1,242	209	19,877
43	13	1,229	207	19,670
44	13	1,217	205	19,465

continued

Table D.2-4 (*continued*)
Mechanical Recovery of 2,500- and 40,000-bbl Spills, 6 P.M. (1800)

	2,500-bbl Spill*		40,000-bbl Spill†	
Hours After Spill‡	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate	Oil Remaining on Surface of Water at End of Each Hour
45	13	1,204	203	19,262
46	13	1,191	201	19,062
47	12	1,179	199	18,863
48	12	1,167	196	18,667
49	0	1,167	0	18,667
50	0	1,167	0	18,667
51	0	1,167	0	18,667
52	0	1,167	0	18,667
53	0	1,167	0	18,667
54	0	1,167	0	18,667
55	0	1,167	0	18,667
56	0	1,167	0	18,667
57	0	1,167	0	18,667
58	0	1,167	0	18,667
59	0	1,167	0	18,667
60	0	1,167	0	18,667
61	12	1,155	194	18,472
62	12	1,142	192	18,280
63	12	1,131	190	18,089
64	12	1,119	188	17,901
65	12	1,107	186	17,715
66	12	1,096	185	17,530
67	11	1,084	183	17,347
68	11	1,073	181	17,167
69	11	1,062	179	16,988
70	11	1,051	177	16,811
71	11	1,040	175	16,636
72	11	1,029	173	16,463
73	0	1,029	0	16,463
74	0	1,029	0	16,463
75	0	1,029	0	16,463
76	0	1,029	0	16,463
77	0	1,029	0	16,463
78	0	1,029	0	16,463
79	0	1,029	0	16,463
80	0	1,029	0	16,463
81	0	1,029	0	16,463
82	0	1,029	0	16,463
83	0	1,029	0	16,463

continued

Table D.2-4 (*continued*)
Mechanical Recovery of 2,500- and 40,000-bbl Spills, 6 P.M. (1800)

Hours After Spill‡	2,500-bbl Spill* Estimated Hourly Removal Rate	2,500-bbl Spill* Oil Remaining on Surface of Water at End of Each Hour	40,000-bbl Spill† Estimated Hourly Removal Rate	40,000-bbl Spill† Oil Remaining on Surface of Water at End of Each Hour
84	0	1,029	0	16,463
85	11	1,018	171	16,291
86	11	1,008	170	16,121
87	10	997	168	15,953
88	10	987	166	15,787
89	10	976	164	15,623
90	10	966	163	15,460
91	10	956	161	15,299
92	10	946	159	15,140
93	10	936	158	14,982
94	10	927	156	14,826
95	10	917	154	14,671
96	10	907	153	14,519

* 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

‡ Shaded cells denote nighttime hours.

D.3. DATA DESCRIPTION—*IN SITU* BURNING (TABLES D.3-1 THROUGH D.3-4)

- *In situ* burning is assumed to be as effective as mechanical recovery.
- Assumed response tiers are the same as those used for mechanical recovery.
- Because the rule proposed to allow *in situ* burning to offset the existing mechanical recovery requirements by 25 percent, *in situ* burning is assumed to remove 25 percent of the available oil each hour, while the amount removed using mechanical recovery is reduced by 25 percent.

Table D.3-1
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, Midnight (0000)

Hours After Spill‡	2,500-bbl Spill* Estimated Hourly Removal Rate: Mechanical Recovery	2,500-bbl Spill* Estimated Hourly Removal Rate: *In Situ* Burning	2,500-bbl Spill* Oil Remaining on Surface of Water at End of Each Hour	40,000-bbl Spill† Estimated Hourly Removal Rate: Mechanical Recovery	40,000-bbl Spill† Estimated Hourly Removal Rate: *In Situ* Burning	40,000-bbl Spill† Oil Remaining on Surface of Water at End of Each Hour
0–6	0	0	1,500	0	0	24,000
7	12	4	1,484	250	0	23,750
8	12	4	1,469	247	0	23,503
9	11	4	1,454	245	0	23,258
10	11	4	1,438	242	0	23,016
11	11	4	1,423	240	0	22,776

continued

Table D.3-1 (*continued*)
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, Midnight (0000)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate			Estimated Hourly Removal Rate		
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour
12	11	4	1,409	237	0	22,539
13	11	4	1,394	235	0	22,304
14	11	4	1,379	232	0	22,071
15	11	4	1,365	230	0	21,842
16	11	4	1,351	228	0	21,614
17	11	4	1,337	225	0	21,389
18	10	3	1,323	223	0	21,166
19	0	0	1,323	0	55	21,166
20	0	0	1,323	0	55	21,166
21	0	0	1,323	0	55	21,166
22	0	0	1,323	0	55	21,166
23	0	0	1,323	0	55	21,166
24	0	0	1,323	0	55	21,166
25	0	0	1,323	0	55	21,166
26	0	0	1,323	0	55	21,166
27	0	0	1,323	0	55	21,166
28	0	0	1,323	0	55	21,166
29	0	0	1,323	0	55	21,166
30	0	0	1,323	0	55	21,166
31	10	3	1,309	220	0	20,946
32	10	3	1,295	218	0	20,727
33	10	3	1,282	216	0	20,511
34	10	3	1,269	214	0	20,298
35	10	3	1,255	211	0	20,086
36	10	3	1,242	209	0	19,877
37	10	3	1,229	207	0	19,670
38	10	3	1,217	205	0	19,465
39	10	3	1,204	203	0	19,262
40	9	3	1,191	201	0	19,062
41	9	3	1,179	199	0	18,863
42	9	3	1,167	196	0	18,667
43	0	0	1,167	0	49	18,667
44	0	0	1,167	0	49	18,667
45	0	0	1,167	0	49	18,667
46	0	0	1,167	0	49	18,667
47	0	0	1,167	0	49	18,667
48	0	0	1,167	0	49	18,667
49	0	0	1,167	0	49	18,667
50	0	0	1,167	0	49	18,667

continued

Table D.3-1 (*continued*)
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, Midnight (0000)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate		Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate		Oil Remaining on Surface of Water at End of Each Hour
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning		Mechanical Recovery	*In Situ* Burning	
51	0	0	1,167	0	49	18,667
52	0	0	1,167	0	49	18,667
53	0	0	1,167	0	49	18,667
54	0	0	1,167	0	49	18,667
55	9	3	1,155	194	0	18,472
56	9	3	1,142	192	0	18,280
57	9	3	1,131	190	0	18,089
58	9	3	1,119	188	0	17,901
59	9	3	1,107	186	0	17,715
60	9	3	1,096	185	0	17,530
61	9	3	1,084	183	0	17,347
62	8	3	1,073	181	0	17,167
63	8	3	1,062	179	0	16,988
64	8	3	1,051	177	0	16,811
65	8	3	1,040	175	0	16,636
66	8	3	1,029	173	0	16,463
67	0	0	1,029	0	43	16,463
68	0	0	1,029	0	43	16,463
69	0	0	1,029	0	43	16,463
70	0	0	1,029	0	43	16,463
71	0	0	1,029	0	43	16,463
72	0	0	1,029	0	43	16,463
73	0	0	1,029	0	43	16,463
74	0	0	1,029	0	43	16,463
75	0	0	1,029	0	43	16,463
76	0	0	1,029	0	43	16,463
77	0	0	1,029	0	43	16,463
78	0	0	1,029	0	43	16,463
79	8	3	1,018	171	0	16,291
80	8	3	1,008	170	0	16,121
81	8	3	997	168	0	15,953
82	8	3	987	166	0	15,787
83	8	3	976	164	0	15,623
84	8	3	966	163	0	15,460
85	8	3	956	161	0	15,299
86	7	2	946	159	0	15,140
87	7	2	936	158	0	14,982
88	7	2	927	156	0	14,826
89	7	2	917	154	0	14,671
90	7	2	907	153	0	14,519

continued

Table D.3-1 (*continued*)
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, Midnight (0000)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate			Estimated Hourly Removal Rate		
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour
91	0	0	907	0	38	14,519
92	0	0	907	0	38	14,519
93	0	0	907	0	38	14,519
94	0	0	907	0	38	14,519
95	0	0	907	0	38	14,519
96	0	0	907	0	38	14,519

* 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

† 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

‡ Shaded cells denote nighttime hours.

Table D.3-2
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, 6 A.M. (0600)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate			Estimated Hourly Removal Rate		
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour
0–6	0	0	1,500	0	0	24,000
7	0	0	1,500	0	0	24,000
8	0	0	1,500	0	0	24,000
9	0	0	1,500	0	0	24,000
10	0	0	1,500	0	0	24,000
11	0	0	1,500	0	0	24,000
12	0	0	1,500	0	0	24,000
13	0	0	1,500	0	0	24,000
14	0	0	1,500	0	0	24,000
15	0	0	1,500	0	0	24,000
16	0	0	1,500	0	0	24,000
17	0	0	1,500	0	0	24,000
18	0	0	1,500	0	0	24,000
19	0	0	1,500	0	0	24,000
20	0	0	1,500	0	0	24,000
21	0	0	1,500	0	0	24,000
22	0	0	1,500	0	0	24,000
23	0	0	1,500	0	0	24,000
24	0	0	1,500	0	0	24,000
25	12	4	1,484	188	63	23,750
26	12	4	1,469	186	62	23,503
27	11	4	1,454	184	61	23,258

continued

Table D.3-2 (*continued*)
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, 6 A.M. (0600)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate			Estimated Hourly Removal Rate		
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour
28	11	4	1,438	182	61	23,016
29	11	4	1,423	180	60	22,776
30	11	4	1,409	178	59	22,539
31	11	4	1,394	176	59	22,304
32	11	4	1,379	174	58	22,071
33	11	4	1,365	172	57	21,842
34	11	4	1,351	171	57	21,614
35	11	4	1,337	169	56	21,389
36	10	3	1,323	167	56	21,166
37	0	0	1,323	0	0	21,166
38	0	0	1,323	0	0	21,166
39	0	0	1,323	0	0	21,166
40	0	0	1,323	0	0	21,166
41	0	0	1,323	0	0	21,166
42	0	0	1,323	0	0	21,166
43	0	0	1,323	0	0	21,166
44	0	0	1,323	0	0	21,166
45	0	0	1,323	0	0	21,166
46	0	0	1,323	0	0	21,166
47	0	0	1,323	0	0	21,166
48	0	0	1,323	0	0	21,166
49	10	3	1,309	165	55	20,946
50	10	3	1,295	164	55	20,727
51	10	3	1,282	162	54	20,511
52	10	3	1,269	160	53	20,298
53	10	3	1,255	159	53	20,086
54	10	3	1,242	157	52	19,877
55	10	3	1,229	155	52	19,670
56	10	3	1,217	154	51	19,465
57	10	3	1,204	152	51	19,262
58	9	3	1,191	150	50	19,062
59	9	3	1,179	149	50	18,863
60	9	3	1,167	147	49	18,667
61	0	0	1,167	0	0	18,667
62	0	0	1,167	0	0	18,667
63	0	0	1,167	0	0	18,667
64	0	0	1,167	0	0	18,667
65	0	0	1,167	0	0	18,667

continued

Table D.3-2 (*continued*)
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, 6 A.M. (0600)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate			Estimated Hourly Removal Rate		
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour
66	0	0	1,167	0	0	18,667
67	0	0	1,167	0	0	18,667
68	0	0	1,167	0	0	18,667
69	0	0	1,167	0	0	18,667
70	0	0	1,167	0	0	18,667
71	0	0	1,167	0	0	18,667
72	0	0	1,167	0	0	18,667
73	9	3	1,155	146	49	18,472
74	9	3	1,142	144	48	18,280
75	9	3	1,131	143	48	18,089
76	9	3	1,119	141	47	17,901
77	9	3	1,107	140	47	17,715
78	9	3	1,096	138	46	17,530
79	9	3	1,084	137	46	17,347
80	8	3	1,073	136	45	17,167
81	8	3	1,062	134	45	16,988
82	8	3	1,051	133	44	16,811
83	8	3	1,040	131	44	16,636
84	8	3	1,029	130	43	16,463
85	0	0	1,029	0	0	16,463
86	0	0	1,029	0	0	16,463
87	0	0	1,029	0	0	16,463
88	0	0	1,029	0	0	16,463
89	0	0	1,029	0	0	16,463
90	0	0	1,029	0	0	16,463
91	0	0	1,029	0	0	16,463
92	0	0	1,029	0	0	16,463
93	0	0	1,029	0	0	16,463
94	0	0	1,029	0	0	16,463
95	0	0	1,029	0	0	16,463
96	0	0	1,029	0	0	16,463

* 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

† 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

‡ Shaded cells denote nighttime hours.

Table D.3-3
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, Noon (1200)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate		Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate		Oil Remaining on Surface of Water at End of Each Hour
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning		Mechanical Recovery	*In Situ* Burning	
0–6	0	0	1,500	0	0	24,000
7	0	0	1,500	0	0	24,000
8	0	0	1,500	0	0	24,000
9	0	0	1,500	0	0	24,000
10	0	0	1,500	0	0	24,000
11	0	0	1,500	0	0	24,000
12	0	0	1,500	0	0	24,000
13	0	0	1,500	0	0	24,000
14	0	0	1,500	0	0	24,000
15	0	0	1,500	0	0	24,000
16	0	0	1,500	0	0	24,000
17	0	0	1,500	0	0	24,000
18	0	0	1,500	0	0	24,000
19	12	4	1,484	188	63	23,750
20	12	4	1,469	186	62	23,503
21	11	4	1,454	184	61	23,258
22	11	4	1,438	182	61	23,016
23	11	4	1,423	180	60	22,776
24	11	4	1,409	178	59	22,539
25	11	4	1,394	176	59	22,304
26	11	4	1,379	174	58	22,071
27	11	4	1,365	172	57	21,842
28	11	4	1,351	171	57	21,614
29	11	4	1,337	169	56	21,389
30	10	3	1,323	167	56	21,166
31	0	0	1,323	0	0	21,166
32	0	0	1,323	0	0	21,166
33	0	0	1,323	0	0	21,166
34	0	0	1,323	0	0	21,166
35	0	0	1,323	0	0	21,166
36	0	0	1,323	0	0	21,166
37	0	0	1,323	0	0	21,166
38	0	0	1,323	0	0	21,166
39	0	0	1,323	0	0	21,166
40	0	0	1,323	0	0	21,166
41	0	0	1,323	0	0	21,166
42	0	0	1,323	0	0	21,166

continued

Table D.3-3 (*continued*)
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, Noon (1200)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate			Estimated Hourly Removal Rate		
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour
43	10	3	1,309	165	55	20,946
44	10	3	1,295	164	55	20,727
45	10	3	1,282	162	54	20,511
46	10	3	1,269	160	53	20,298
47	10	3	1,255	159	53	20,086
48	10	3	1,242	157	52	19,877
49	10	3	1,229	155	52	19,670
50	10	3	1,217	154	51	19,465
51	10	3	1,204	152	51	19,262
52	9	3	1,191	150	50	19,062
53	9	3	1,179	149	50	18,863
54	9	3	1,167	147	49	18,667
55	0	0	1,167	0	0	18,667
56	0	0	1,167	0	0	18,667
57	0	0	1,167	0	0	18,667
58	0	0	1,167	0	0	18,667
59	0	0	1,167	0	0	18,667
60	0	0	1,167	0	0	18,667
61	0	0	1,167	0	0	18,667
62	0	0	1,167	0	0	18,667
63	0	0	1,167	0	0	18,667
64	0	0	1,167	0	0	18,667
65	0	0	1,167	0	0	18,667
66	0	0	1,167	0	0	18,667
67	9	3	1,155	146	49	18,472
68	9	3	1,142	144	48	18,280
69	9	3	1,131	143	48	18,089
70	9	3	1,119	141	47	17,901
71	9	3	1,107	140	47	17,715
72	9	3	1,096	138	46	17,530
73	9	3	1,084	137	46	17,347
74	8	3	1,073	136	45	17,167
75	8	3	1,062	134	45	16,988
76	8	3	1,051	133	44	16,811
77	8	3	1,040	131	44	16,636
78	8	3	1,029	130	43	16,463
79	0	0	1,029	0	0	16,463
80	0	0	1,029	0	0	16,463
81	0	0	1,029	0	0	16,463

continued

Table D.3-3 (*continued*)
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, Noon (1200)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate			Estimated Hourly Removal Rate		
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour
82	0	0	1,029	0	0	16,463
83	0	0	1,029	0	0	16,463
84	0	0	1,029	0	0	16,463
85	0	0	1,029	0	0	16,463
86	0	0	1,029	0	0	16,463
87	0	0	1,029	0	0	16,463
88	0	0	1,029	0	0	16,463
89	0	0	1,029	0	0	16,463
90	0	0	1,029	0	0	16,463
91	8	3	1,018	129	43	16,291
92	8	3	1,008	127	42	16,121
93	8	3	997	126	42	15,953
94	8	3	987	125	42	15,787
95	8	3	976	123	41	15,623
96	8	3	966	122	41	15,460

* 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

† 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

‡ Shaded cells denote nighttime hours.

Table D.3-4
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, 6 P.M. (1800)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate			Estimated Hourly Removal Rate		
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour
0–6	0	0	1,500	0	0	24,000
7	0	0	1,500	0	0	24,000
8	0	0	1,500	0	0	24,000
9	0	0	1,500	0	0	24,000
10	0	0	1,500	0	0	24,000
11	0	0	1,500	0	0	24,000
12	0	0	1,500	0	0	24,000
13	12	4	1,484	188	63	23,750
14	12	4	1,469	186	62	23,503
15	11	4	1,454	184	61	23,258
16	11	4	1,438	182	61	23,016
17	11	4	1,423	180	60	22,776

continued

Table D.3-4 (*continued*)
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, 6 P.M. (1800)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate			Estimated Hourly Removal Rate		
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour
18	11	4	1,409	178	59	22,539
19	11	4	1,394	176	59	22,304
20	11	4	1,379	174	58	22,071
21	11	4	1,365	172	57	21,842
22	11	4	1,351	171	57	21,614
23	11	4	1,337	169	56	21,389
24	10	3	1,323	167	56	21,166
25	0	0	1,323	0	0	21,166
26	0	0	1,323	0	0	21,166
27	0	0	1,323	0	0	21,166
28	0	0	1,323	0	0	21,166
29	0	0	1,323	0	0	21,166
30	0	0	1,323	0	0	21,166
31	0	0	1,323	0	0	21,166
32	0	0	1,323	0	0	21,166
33	0	0	1,323	0	0	21,166
34	0	0	1,323	0	0	21,166
35	0	0	1,323	0	0	21,166
36	0	0	1,323	0	0	21,166
37	10	3	1,309	165	55	20,946
38	10	3	1,295	164	55	20,727
39	10	3	1,282	162	54	20,511
40	10	3	1,269	160	53	20,298
41	10	3	1,255	159	53	20,086
42	10	3	1,242	157	52	19,877
43	10	3	1,229	155	52	19,670
44	10	3	1,217	154	51	19,465
45	10	3	1,204	152	51	19,262
46	9	3	1,191	150	50	19,062
47	9	3	1,179	149	50	18,863
48	9	3	1,167	147	49	18,667
49	0	0	1,167	0	0	18,667
50	0	0	1,167	0	0	18,667
51	0	0	1,167	0	0	18,667
52	0	0	1,167	0	0	18,667
53	0	0	1,167	0	0	18,667
54	0	0	1,167	0	0	18,667
55	0	0	1,167	0	0	18,667

continued

Table D.3-4 (*continued*)
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, 6 P.M. (1800)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate		Oil Remaining on Surface of Water at End of Each Hour	Estimated Hourly Removal Rate		Oil Remaining on Surface of Water at End of Each Hour
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning		Mechanical Recovery	*In Situ* Burning	
56	0	0	1,167	0	0	18,667
57	0	0	1,167	0	0	18,667
58	0	0	1,167	0	0	18,667
59	0	0	1,167	0	0	18,667
60	0	0	1,167	0	0	18,667
61	9	3	1,155	146	49	18,472
62	9	3	1,142	144	48	18,280
63	9	3	1,131	143	48	18,089
64	9	3	1,119	141	47	17,901
65	9	3	1,107	140	47	17,715
66	9	3	1,096	138	46	17,530
67	9	3	1,084	137	46	17,347
68	8	3	1,073	136	45	17,167
69	8	3	1,062	134	45	16,988
70	8	3	1,051	133	44	16,811
71	8	3	1,040	131	44	16,636
72	8	3	1,029	130	43	16,463
73	0	0	1,029	0	0	16,463
74	0	0	1,029	0	0	16,463
75	0	0	1,029	0	0	16,463
76	0	0	1,029	0	0	16,463
77	0	0	1,029	0	0	16,463
78	0	0	1,029	0	0	16,463
79	0	0	1,029	0	0	16,463
80	0	0	1,029	0	0	16,463
81	0	0	1,029	0	0	16,463
82	0	0	1,029	0	0	16,463
83	0	0	1,029	0	0	16,463
84	0	0	1,029	0	0	16,463
85	8	3	1,018	129	43	16,291
86	8	3	1,008	127	42	16,121
87	8	3	997	126	42	15,953
88	8	3	987	125	42	15,787
89	8	3	976	123	41	15,623
90	8	3	966	122	41	15,460
91	8	3	956	121	40	15,299
92	7	2	946	120	40	15,140
93	7	2	936	118	39	14,982

continued

Table D.3-4 (*continued*)
Mechanical Recovery/*In Situ* Burning of 2,500- and 40,000-bbl Spills, 6 P.M. (1800)

	2,500-bbl Spill*			40,000-bbl Spill†		
	Estimated Hourly Removal Rate			Estimated Hourly Removal Rate		
Hours After Spill‡	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour	Mechanical Recovery	*In Situ* Burning	Oil Remaining on Surface of Water at End of Each Hour
94	7	2	927	117	39	14,826
95	7	2	917	116	39	14,671
96	7	2	907	115	38	14,519

* 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

† 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

‡ Shaded cells denote nighttime hours.

D.4. DATA DESCRIPTION—CHEMICAL DISPERSION (TABLES D.4-1 THROUGH D.4-16)

- Dispersant amounts will be listed in gallons; all oil quantities will be listed in barrels.
- Dispersant operations will be completed at hour 60 after the start of the spill.
  - Tier 1, hours 6 to 12
  - Tier 2, hours 12 to 36
  - Tier 3, hours 36 to 60
- Two efficiencies will be used for dispersants:
  - **Eighty percent—**Dispersant/dispersed oil impact on the water column based on theoretically successful dispersant operation. Recent ecological risk assessments (Pond et al., 2000a, b) done by response communities in California and Texas have used 80 percent as a high-end effectiveness estimator.
  - **Forty-five percent—**Dispersant/dispersed oil impact on the water column based on minimum dispersant effectiveness criteria established in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).
- For dispersants at all tiers, application will be assumed to be made using one or more C-130 aircraft. According to the *Response Plan Equipment Caps Review* (USCG, 1999), the C-130 is capable of delivering 5,495 gal of dispersant per sortie.
  - Gulf of Mexico Tier 1 would require delivery of 8,250 gal of dispersant in two sorties over the course of 5 hours starting at hour 7 or at the first hour of daylight: first sortie, 5,494 gal; second sortie 5 hours later, 2,756 gal.
  - Non–Gulf of Mexico Tier 1 would require delivery of 4,125 gal in one C-130 sortie at hour 7 or at the first hour of daylight.
  - Tier II and III each require delivery of 23,375 gal of dispersant in four sorties of 5,495 gal each and one sortie of 1,395 gal. Sorties will occur at tier start time +1, 3, 5, 7, and 9 hours.
- When sorties from two tiers overlap because of darkness, both sorties will be assumed to occur simultaneously.

Table D.4-1
Dispersant Use on a 2,500-bbl Spill in the Gulf of Mexico, Midnight (0000)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0	0	1,500	0	0	1,500
7	3,938	1,500	0	5,495	1,178	323
8	0	0	0	0	0	323
9	0	0	0	0	0	323
10	0	0	0	0	0	323
11	0	0	0	0	0	323
12	0	0	0	1,505	323	0
13	All oil has been dispersed					
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						

* Shaded cells denote nighttime hours.

† 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

Table D.4-2
Dispersant Use on a 2,500-bbl Spill in the Gulf of Mexico, 6 A.M. (0600)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0	0	1,500	0	0	1,500
7	3,938	1,500	0	5,495	1,178	323
8	0	0	0	0	0	323
9	0	0	0	0	0	323
10	0	0	0	0	0	323
11	0	0	0	0	0	323
12	0	0	0	1,505	323	0
13	All oil has been dispersed					
14						
15						
16						

continued

Table D.4-2 (*continued*)
Dispersant Use on a 2,500-bbl Spill in the Gulf of Mexico, 6 A.M. (0600)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
17						
18						
19						
20						
21						
22						
23						
24						

* Shaded cells denote nighttime hours.

† 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

Table D.4-3
Dispersant Use on a 2,500-bbl Spill in the Gulf of Mexico, Noon (1200)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0	0	1,500	0	0	1,500
7	0	0	1,500	0	0	1,500
8	0	0	1,500	0	0	1,500
9	0	0	1,500	0	0	1,500
10	0	0	1,500	0	0	1,500
11	0	0	1,500	0	0	1,500
12	0	0	1,500	0	0	1,500
13	0	0	1,500	0	0	1,500
14	0	0	1,500	0	0	1,500
15	0	0	1,500	0	0	1,500
16	0	0	1,500	0	0	1,500
17	0	0	1,500	0	0	1,500
18	0	0	1,500	0	0	1,500
19	3,938	1,500	0	7,000	1,500	0
20	All oil has been dispersed					
21						
22						
23						
24						

* Shaded cells denote nighttime hours.

† 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

Table D.4-4
Dispersant Use on a 2,500-bbl Spill in the Gulf of Mexico, 6 P.M. (1800)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0	0	1,500	0	0	1,500
7	0	0	1,500	0	0	1,500
8	0	0	1,500	0	0	1,500
9	0	0	1,500	0	0	1,500
10	0	0	1,500	0	0	1,500
11	0	0	1,500	0	0	1,500
12	0	0	1,500	0	0	1,500
13	3,938	1,500	0	7,000	1,500	0
14			All oil has been dispersed			
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						

* Shaded cells denote nighttime hours.

† 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

Table D.4-5
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, Midnight (0000)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0		24,000	0		24,000
7	5,495	2,093	21,907	5,495	1,178	22,823
8	0	0	21,907	0	0	22,823
9	0	0	21,907	0	0	22,823
10	0	0	21,907	0	0	22,823
11	0	0	21,907	0	0	22,823
12	2,756	1,050	20,857	2,756	5,91	22,232
13	0	0	20,857	0	0	22,232
14	5,495	2,093	18,763	5,495	1,178	21,054
15	0	0	18,763	0	0	21,054

continued

Table D.4-5 (*continued*)
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, Midnight (0000)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
16	5,495	2,093	16,670	5,495	1,178	19,877
17	0	0	16,670	0	0	19,877
18	5,495	2,093	14,577	5,495	1,178	18,699
19	0	0	14,577	0	0	18,699
20	0	0	14,577	0	0	18,699
21	0	0	14,577	0	0	18,699
22	0	0	14,577	0	0	18,699
23	0	0	14,577	0	0	18,699
24	0	0	14,577	0	0	18,699
25	0	0	14,577	0	0	18,699
26	0	0	14,577	0	0	18,699
27	0	0	14,577	0	0	18,699
28	0	0	14,577	0	0	18,699
29	0	0	14,577	0	0	18,699
30	0	0	14,577	0	0	18,699
31	5,495	2,093	12,483	5,495	1,178	17,522
32	0	0	12,483	0	0	17,522
33	1,395	531	11,952	1,395	299	17,223
34	0	0	11,952	0	0	17,223
35	0	0	11,952	0	0	17,223
36	0	0	11,952	0	0	17,223
37	0	0	11,952	0	0	17,223
38	5,495	2,093	9,859	5,495	1,178	16,046
39	0	0	9,859	0	0	16,046
40	5,495	2,093	7,765	5,495	1,178	14,868
41	0	0	7,765	0	0	14,868
42	5,495	2,093	5,672	5,495	1,178	13,691
43	0	0	5,672	0	0	13,691
44	0	0	5,672	0	0	13,691
45	0	0	5,672	0	0	13,691
46	0	0	5,672	0	0	13,691
47	0	0	5,672	0	0	13,691
48	0	0	5,672	0	0	13,691
49	0	0	5,672	0	0	13,691
50	0	0	5,672	0	0	13,691
51	0	0	5,672	0	0	13,691
52	0	0	5,672	0	0	13,691
53	0	0	5,672	0	0	13,691
54	0	0	5,672	0	0	13,691

continued

Table D.4-5 (*continued*)
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, Midnight (0000)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
55	0	0	5,672	0	0	13,691
56	0	0	5,672	0	0	13,691
57	5,495	2,093	3,579	5,495	1,178	12,513
58	0	0	3,579	0	0	12,513
59	1,395	531	3,047	1,395	299	12,214
60	0	0	3,047	0	0	12,214
61	0	0	3,047	0	0	12,214
62	0	0	3,047	0	0	12,214
63	0	0	3,047	0	0	12,214
64	0	0	3,047	0	0	12,214
65	0	0	3,047	0	0	12,214
66	0	0	3,047	0	0	12,214
67	0	0	3,047	0	0	12,214
68	0	0	3,047	0	0	12,214
69	0	0	3,047	0	0	12,214
70	0	0	3,047	0	0	12,214
71	0	0	3,047	0	0	12,214
72	0	0	3,047	0	0	12,214
73	0	0	3,047	0	0	12,214
74	0	0	3,047	0	0	12,214
75	0	0	3,047	0	0	12,214
76	0	0	3,047	0	0	12,214
77	0	0	3,047	0	0	12,214
78	0	0	3,047	0	0	12,214
79	0	0	3,047	0	0	12,214
80	0	0	3,047	0	0	12,214
81	0	0	3,047	0	0	12,214
82	0	0	3,047	0	0	12,214
83	0	0	3,047	0	0	12,214
84	0	0	3,047	0	0	12,214
85	0	0	3,047	0	0	12,214
86	0	0	3,047	0	0	12,214
87	0	0	3,047	0	0	12,214
88	0	0	3,047	0	0	12,214
89	0	0	3,047	0	0	12,214
90	0	0	3,047	0	0	12,214
91	0	0	3,047	0	0	12,214
92	0	0	3,047	0	0	12,214

continued

Table D.4-5 (*continued*)
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, Midnight (0000)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
93	0	0	3,047	0	0	12,214
94	0	0	3,047	0	0	12,214
95	0	0	3,047	0	0	12,214
96	0	0	3,047	0	0	12,214

* Shaded cells denote nighttime hours.

† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

Table D.4-6
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, 6 A.M. (0600)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0		24,000	0		24,000
7	5,495	2,093	21,907	5,495	1,178	22,823
8	0	0	21,907	0	0	22,823
9	0	0	21,907	0	0	22,823
10	0	0	21,907	0	0	22,823
11	0	0	21,907	0	0	22,823
12	2,756	1,050	20,857	2,756	591	22,232
13	0	0	20,857	0	0	22,232
14	0	0	20,857	0	0	22,232
15	0	0	20,857	0	0	22,232
16	0	0	20,857	0	0	22,232
17	0	0	20,857	0	0	22,232
18	0	0	20,857	0	0	22,232
19	0	0	20,857	0	0	22,232
20	0	0	20,857	0	0	22,232
21	0	0	20,857	0	0	22,232
22	0	0	20,857	0	0	22,232
23	0	0	20,857	0	0	22,232
24	0	0	20,857	0	0	22,232
25	0	0	20,857	0	0	22,232
26	5,495	2,093	18,763	5,495	1,178	21,054
27	0	0	18,763	0	0	21,054
28	5,495	2,093	16,670	5,495	1,178	19,877
29	0	0	16,670	0	0	19,877

continued

Table D.4-6 (*continued*)
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, 6 A.M. (0600)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
30	5,495	2,093	14,577	5,495	1,178	18,699
31	0	0	14,577	0	0	18,699
32	5,495	2,093	12,483	5,495	1,178	17,522
33	0	0	12,483	0	0	17,522
34	1,395	531	11,952	1,395	299	17,223
35	0	0	11,952	0	0	17,223
36	0	0	11,952	0	0	17,223
37	0	0	11,952	0	0	17,223
38	0	0	11,952	0	0	17,223
39	0	0	11,952	0	0	17,223
40	0	0	11,952	0	0	17,223
41	0	0	11,952	0	0	17,223
42	0	0	11,952	0	0	17,223
43	0	0	11,952	0	0	17,223
44	0	0	11,952	0	0	17,223
45	0	0	11,952	0	0	17,223
46	0	0	11,952	0	0	17,223
47	0	0	11,952	0	0	17,223
48	0	0	11,952	0	0	17,223
49	0	0	11,952	0	0	17,223
50	5,495	2,093	9,859	5,495	1,178	16,046
51	0	0	9,859	0	0	16,046
52	5,495	2,093	7,765	5,495	1,178	14,868
53	0	0	7,765	0	0	14,868
54	5,495	2,093	5,672	5,495	1,178	13,691
55	0	0	5,672	0	0	13,691
56	5,495	2,093	3,579	5,495	1,178	12,513
57	0	0	3,579	0	0	12,513
58	1,395	531	3,047	1,395	299	12,214
59	0	0	3,047	0	0	12,214
60	0	0	3,047	0	0	12,214
61	0	0	3,047	0	0	12,214
62	0	0	3,047	0	0	12,214
63	0	0	3,047	0	0	12,214
64	0	0	3,047	0	0	12,214
65	0	0	3,047	0	0	12,214
66	0	0	3,047	0	0	12,214
67	0	0	3,047	0	0	12,214
68	0	0	3,047	0	0	12,214

continued

Table D.4-6 (*continued*)
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, 6 A.M. (0600)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
69	0	0	3,047	0	0	12,214
70	0	0	3,047	0	0	12,214
71	0	0	3,047	0	0	12,214
72	0	0	3,047	0	0	12,214
73	0	0	3,047	0	0	12,214
74	0	0	3,047	0	0	12,214
75	0	0	3,047	0	0	12,214
76	0	0	3,047	0	0	12,214
77	0	0	3,047	0	0	12,214
78	0	0	3,047	0	0	12,214
79	0	0	3,047	0	0	12,214
80	0	0	3,047	0	0	12,214
81	0	0	3,047	0	0	12,214
82	0	0	3,047	0	0	12,214
83	0	0	3,047	0	0	12,214
84	0	0	3,047	0	0	12,214
85	0	0	3,047	0	0	12,214
86	0	0	3,047	0	0	12,214
87	0	0	3,047	0	0	12,214
88	0	0	3,047	0	0	12,214
89	0	0	3,047	0	0	12,214
90	0	0	3,047	0	0	12,214
91	0	0	3,047	0	0	12,214
92	0	0	3,047	0	0	12,214
93	0	0	3,047	0	0	12,214
94	0	0	3,047	0	0	12,214
95	0	0	3,047	0	0	12,214
96	0	0	3,047	0	0	12,214

* Shaded cells denote nighttime hours.

† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

Table D.4-7
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, Noon (1200)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0		24,000	0		24,000
7	0	0	24,000	0	0	24,000
8	0	0	24,000	0	0	24,000
9	0	0	24,000	0	0	24,000
10	0	0	24,000	0	0	24,000
11	0	0	24,000	0	0	24,000
12	0	0	24,000	0	0	24,000
13	0	0	24,000	0	0	24,000
14	0	0	24,000	0	0	24,000
15	0	0	24,000	0	0	24,000
16	0	0	24,000	0	0	24,000
17	0	0	24,000	0	0	24,000
18	0	0	24,000	0	0	24,000
19	5,495	2,093	21,907	5,495	1,178	22,823
20	8,251	3,143	18,763	8,251	1,768	21,054
21	0	0	18,763	0	0	21,054
22	5,495	2,093	16,670	5,495	1,178	19,877
23	0	0	16,670	0	0	19,877
24	5,495	2,093	14,577	5,495	1,178	18,699
25	0	0	14,577	0	0	18,699
26	5,495	2,093	12,483	5,495	1,178	17,522
27	0	0	12,483	0	0	17,522
28	1,395	531	11,952	1,395	299	17,223
29	0	0	11,952	0	0	17,223
30	0	0	11,952	0	0	17,223
31	0	0	11,952	0	0	17,223
32	0	0	11,952	0	0	17,223
33	0	0	11,952	0	0	17,223
34	0	0	11,952	0	0	17,223
35	0	0	11,952	0	0	17,223
36	0	0	11,952	0	0	17,223
37	0	0	11,952	0	0	17,223
38	0	0	11,952	0	0	17,223
39	0	0	11,952	0	0	17,223
40	0	0	11,952	0	0	17,223
41	0	0	11,952	0	0	17,223
42	0	0	11,952	0	0	17,223
43	5,495	2,093	9,859	5,495	1,178	16,046
44	0	0	9,859	0	0	16,046
45	5,495	2,093	7,765	5,495	1,178	14,868
46	0	0	7,765	0	0	14,868

continued

Table D.4-7 (*continued*)
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, Noon (1200)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
47	5,495	2,093	5,672	5,495	1,178	13,691
48	0	0	5,672	0	0	13,691
49	5,495	2,093	3,579	5,495	1,178	12,513
50	0	0	3,579	0	0	12,513
51	1,395	531	3,047	1,395	299	12,214
52	0	0	3,047	0	0	12,214
53	0	0	3,047	0	0	12,214
54	0	0	3,047	0	0	12,214
55	0	0	3,047	0	0	12,214
56	0	0	3,047	0	0	12,214
57	0	0	3,047	0	0	12,214
58	0	0	3,047	0	0	12,214
59	0	0	3,047	0	0	12,214
60	0	0	3,047	0	0	12,214
61	0	0	3,047	0	0	12,214
62	0	0	3,047	0	0	12,214
63	0	0	3,047	0	0	12,214
64	0	0	3,047	0	0	12,214
65	0	0	3,047	0	0	12,214
66	0	0	3,047	0	0	12,214
67	0	0	3,047	0	0	12,214
68	0	0	3,047	0	0	12,214
69	0	0	3,047	0	0	12,214
70	0	0	3,047	0	0	12,214
71	0	0	3,047	0	0	12,214
72	0	0	3,047	0	0	12,214
73	0	0	3,047	0	0	12,214
74	0	0	3,047	0	0	12,214
75	0	0	3,047	0	0	12,214
76	0	0	3,047	0	0	12,214
77	0	0	3,047	0	0	12,214
78	0	0	3,047	0	0	12,214
79	0	0	3,047	0	0	12,214
80	0	0	3,047	0	0	12,214
81	0	0	3,047	0	0	12,214
82	0	0	3,047	0	0	12,214
83	0	0	3,047	0	0	12,214
84	0	0	3,047	0	0	12,214
85	0	0	3,047	0	0	12,214
86	0	0	3,047	0	0	12,214

continued

Table D.4-7 (*continued*)
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, Noon (1200)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
87	0	0	3,047	0	0	12,214
88	0	0	3,047	0	0	12,214
89	0	0	3,047	0	0	12,214
90	0	0	3,047	0	0	12,214
91	0	0	3,047	0	0	12,214
92	0	0	3,047	0	0	12,214
93	0	0	3,047	0	0	12,214
94	0	0	3,047	0	0	12,214
95	0	0	3,047	0	0	12,214
96	0	0	3,047	0	0	12,214

* Shaded cells denote nighttime hours.

† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

Table D.4-8
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, 6 P.M. (1800)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0		24,000	0		24,000
7	0	0	24,000	0	0	24,000
8	0	0	24,000	0	0	24,000
9	0	0	24,000	0	0	24,000
10	0	0	24,000	0	0	24,000
11	0	0	24,000	0	0	24,000
12	0	0	24,000	0	0	24,000
13	5,495	2,093	21,907	5,495	1,178	22,823
14	8,251	3,143	18,763	8,251	1,768	21,054
15	0	0	18,763	0	0	21,054
16	5,495	2,093	16,670	5,495	1,178	19,877
17	0	0	16,670	0	0	19,877
18	5,495	2,093	14,577	5,495	1,178	18,699
19	0	0	14,577	0	0	18,699
20	5,495	2,093	12,483	5,495	1,178	17,522
21	0	0	12,483	0	0	17,522
22	1,395	531	11,952	1,395	299	17,223
23	0	0	11,952	0	0	17,223
24	0	0	11,952	0	0	17,223
25	0	0	11,952	0	0	17,223

continued

Table D.4-8 (*continued*)
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, 6 P.M. (1800)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
26	0	0	11,952	0	0	17,223
27	0	0	11,952	0	0	17,223
28	0	0	11,952	0	0	17,223
29	0	0	11,952	0	0	17,223
30	0	0	11,952	0	0	17,223
31	0	0	11,952	0	0	17,223
32	0	0	11,952	0	0	17,223
33	0	0	11,952	0	0	17,223
34	0	0	11,952	0	0	17,223
35	0	0	11,952	0	0	17,223
36	0	0	11,952	0	0	17,223
37	0	0	11,952	0	0	17,223
38	5,495	2,093	9,859	5,495	1,178	16,046
39	0	0	9,859	0	0	16,046
40	5,495	2,093	7,765	5,495	1,178	14,868
41	0	0	7,765	0	0	14,868
42	5,495	2,093	5,672	5,495	1,178	13,691
43	0	0	5,672	0	0	13,691
44	5,495	2,093	3,579	5,495	1,178	12,513
45	0	0	3,579	0	0	12,513
46	1,395	531	3,047	1,395	299	12,214
47	0	0	3,047	0	0	12,214
48	0	0	3,047	0	0	12,214
49	0	0	3,047	0	0	12,214
50	0	0	3,047	0	0	12,214
51	0	0	3,047	0	0	12,214
52	0	0	3,047	0	0	12,214
53	0	0	3,047	0	0	12,214
54	0	0	3,047	0	0	12,214
55	0	0	3,047	0	0	12,214
56	0	0	3,047	0	0	12,214
57	0	0	3,047	0	0	12,214
58	0	0	3,047	0	0	12,214
59	0	0	3,047	0	0	12,214
60	0	0	3,047	0	0	12,214
61	0	0	3,047	0	0	12,214
62	0	0	3,047	0	0	12,214
63	0	0	3,047	0	0	12,214
64	0	0	3,047	0	0	12,214
65	0	0	3,047	0	0	12,214
66	0	0	3,047	0	0	12,214

continued

Table D.4-8 (*continued*)
Dispersant Use on a 40,000-bbl Spill in the Gulf of Mexico, 6 P.M. (1800)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
67	0	0	3,047	0	0	12,214
68	0	0	3,047	0	0	12,214
69	0	0	3,047	0	0	12,214
70	0	0	3,047	0	0	12,214
71	0	0	3,047	0	0	12,214
72	0	0	3,047	0	0	12,214
73	0	0	3,047	0	0	12,214
74	0	0	3,047	0	0	12,214
75	0	0	3,047	0	0	12,214
76	0	0	3,047	0	0	12,214
77	0	0	3,047	0	0	12,214
78	0	0	3,047	0	0	12,214
79	0	0	3,047	0	0	12,214
80	0	0	3,047	0	0	12,214
81	0	0	3,047	0	0	12,214
82	0	0	3,047	0	0	12,214
83	0	0	3,047	0	0	12,214
84	0	0	3,047	0	0	12,214
85	0	0	3,047	0	0	12,214
86	0	0	3,047	0	0	12,214
87	0	0	3,047	0	0	12,214
88	0	0	3,047	0	0	12,214
89	0	0	3,047	0	0	12,214
90	0	0	3,047	0	0	12,214
91	0	0	3,047	0	0	12,214
92	0	0	3,047	0	0	12,214
93	0	0	3,047	0	0	12,214
94	0	0	3,047	0	0	12,214
95	0	0	3,047	0	0	12,214
96	0	0	3,047	0	0	12,214

* Shaded cells denote nighttime hours.

† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

Table D.4-9
Dispersant Use on a 2,500-bbl Spill in a Non–Gulf of Mexico Region, Midnight (0000)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0	0	1,500	0	0	1,500
7	3,938	1,500	0	4,125	884	616
8	0	0	0	0	0	616
9	0	0	0	0	0	616
10	0	0	0	0	0	616
11	0	0	0	0	0	616
12	0	0	0	2,875	616	0
13	All oil has been dispersed					
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						

* Shaded cells denote nighttime hours.

† 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

Table D.4-10
Dispersant Use on a 2,500-bbl Spill in a Non–Gulf of Mexico Region, 6 A.M. (0600)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0	0	1,500	0	0	1,500
7	3,938	1,500	0	4,125	884	616
8	0	0	0	0	0	616
9	0	0	0	0	0	616
10	0	0	0	0	0	616
11	0	0	0	0	0	616
12	0	0	0	2,875	616	0
13	All oil has been dispersed					
14						
15						
16						

continued

Table D.4-10 (*continued*)
Dispersant Use on a 2,500-bbl Spill in a Non–Gulf of Mexico Region, 6 A.M. (0600)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
17						
18						
19						
20						
21						
22						
23						
24						

* Shaded cells denote nighttime hours.

† 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

Table D.4-11
Dispersant Use on a 2,500-bbl Spill in a Non–Gulf of Mexico Region, Noon (1200)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0	0	1,500	0	0	1,500
7	0	0	1,500	0	0	1,500
8	0	0	1,500	0	0	1,500
9	0	0	1,500	0	0	1,500
10	0	0	1,500	0	0	1,500
11	0	0	1,500	0	0	1,500
12	0	0	1,500	0	0	1,500
13	0	0	1,500	0	0	1,500
14	0	0	1,500	0	0	1,500
15	0	0	1,500	0	0	1,500
16	0	0	1,500	0	0	1,500
17	0	0	1,500	0	0	1,500
18	0	0	1,500	0	0	1,500
19	3,938	1,500	0	7,000	1,500	0
20	All oil has been dispersed					
21						
22						
23						
24						

* Shaded cells denote nighttime hours.

† 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

Table D.4-12
Dispersant Use on a 2,500-bbl Spill in a Non–Gulf of Mexico Region, 6 P.M. (1800)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0	0	1,500	0	0	1,500
7	0	0	1,500	0	0	1,500
8	0	0	1,500	0	0	1,500
9	0	0	1,500	0	0	1,500
10	0	0	1,500	0	0	1,500
11	0	0	1,500	0	0	1,500
12	0	0	1,500	0	0	1,500
13	3,938	1,500	0	7,000	1,500	0
14	All oil has been dispersed					
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						

* Shaded cells denote nighttime hours.

† 2,500 bbl spilled; 1,000 bbl natural dispersion; 1,500 bbl for treatment/removal at hour 6.

Table D.4-13
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, Midnight (0000)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0		24,000	0		24,000
7	4,125	1,571	22,429	4,125	884	23,116
8	0	0	22,429	0	0	23,116
9	0	0	22,429	0	0	23,116
10	0	0	22,429	0	0	23,116
11	0	0	22,429	0	0	23,116
12	0	0	22,429	0	0	23,116
13	0	0	22,429	0	0	23,116
14	5,495	2,093	20,335	5,495	1,178	21,939
15	0	0	20,335	0	0	21,939

continued

Table D.4-13 (*continued*)
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, Midnight (0000)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
16	5,495	2,093	18,242	5,495	1,178	20,761
17	0	0	18,242	0	0	20,761
18	5,495	2,093	16,149	5,495	1,178	19,584
19	0	0	16,149	0	0	19,584
20	0	0	16,149	0	0	19,584
21	0	0	16,149	0	0	19,584
22	0	0	16,149	0	0	19,584
23	0	0	16,149	0	0	19,584
24	0	0	16,149	0	0	19,584
25	0	0	16,149	0	0	19,584
26	0	0	16,149	0	0	19,584
27	0	0	16,149	0	0	19,584
28	0	0	16,149	0	0	19,584
29	0	0	16,149	0	0	19,584
30	0	0	16,149	0	0	19,584
31	5,495	2,093	14,055	5,495	1,178	18,406
32	0	0	14,055	0	0	18,406
33	1,395	531	13,524	1,395	299	18,107
34	0	0	13,524	0	0	18,107
35	0	0	13,524	0	0	18,107
36	0	0	13,524	0	0	18,107
37	0	0	13,524	0	0	18,107
38	5,495	2,093	11,430	5,495	1,178	16,930
39	0	0	11,430	0	0	16,930
40	5,495	2,093	9,337	5,495	1,178	15,752
41	0	0	9,337	0	0	15,752
42	5,495	2,093	7,244	5,495	1,178	14,575
43	0	0	7,244	0	0	14,575
44	0	0	7,244	0	0	14,575
45	0	0	7,244	0	0	14,575
46	0	0	7,244	0	0	14,575
47	0	0	7,244	0	0	14,575
48	0	0	7,244	0	0	14,575
49	0	0	7,244	0	0	14,575
50	0	0	7,244	0	0	14,575
51	0	0	7,244	0	0	14,575
52	0	0	7,244	0	0	14,575
53	0	0	7,244	0	0	14,575

continued

Table D.4-13 (*continued*)
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, Midnight (0000)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
54	0	0	7,244	0	0	14,575
55	0	0	7,244	0	0	14,575
56	0	0	7,244	0	0	14,575
57	5,495	2,093	5,150	5,495	1,178	13,397
58	0	0	5,150	0	0	13,397
59	1,395	531	4,619	1,395	299	13,098
60	0	0	4,619	0	0	13,098
61	0	0	4,619	0	0	13,098
62	0	0	4,619	0	0	13,098
63	0	0	4,619	0	0	13,098
64	0	0	4,619	0	0	13,098
65	0	0	4,619	0	0	13,098
66	0	0	4,619	0	0	13,098
67	0	0	4,619	0	0	13,098
68	0	0	4,619	0	0	13,098
69	0	0	4,619	0	0	13,098
70	0	0	4,619	0	0	13,098
71	0	0	4,619	0	0	13,098
72	0	0	4,619	0	0	13,098
73	0	0	4,619	0	0	13,098
74	0	0	4,619	0	0	13,098
75	0	0	4,619	0	0	13,098
76	0	0	4,619	0	0	13,098
77	0	0	4,619	0	0	13,098
78	0	0	4,619	0	0	13,098
79	0	0	4,619	0	0	13,098
80	0	0	4,619	0	0	13,098
81	0	0	4,619	0	0	13,098
82	0	0	4,619	0	0	13,098
83	0	0	4,619	0	0	13,098
84	0	0	4,619	0	0	13,098
85	0	0	4,619	0	0	13,098
86	0	0	4,619	0	0	13,098
87	0	0	4,619	0	0	13,098
88	0	0	4,619	0	0	13,098
89	0	0	4,619	0	0	13,098
90	0	0	4,619	0	0	13,098
91	0	0	4,619	0	0	13,098

continued

Table D.4-13 (*continued*)
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, Midnight (0000)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
92	0	0	4,619	0	0	13,098
93	0	0	4,619	0	0	13,098
94	0	0	4,619	0	0	13,098
95	0	0	4,619	0	0	13,098
96	0	0	4,619	0	0	13,098

* Shaded cells denote nighttime hours.

† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

Table D.4-14
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, 6 A.M. (0600)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0		24,000	0		24,000
7	4,125	1,571	22,429	4,125	884	23,116
8	0	0	22,429	0	0	23,116
9	0	0	22,429	0	0	23,116
10	0	0	22,429	0	0	23,116
11	0	0	22,429	0	0	23,116
12	0	0	22,429	0	0	23,116
13	0	0	22,429	0	0	23,116
14	0	0	22,429	0	0	23,116
15	0	0	22,429	0	0	23,116
16	0	0	22,429	0	0	23,116
17	0	0	22,429	0	0	23,116
18	0	0	22,429	0	0	23,116
19	0	0	22,429	0	0	23,116
20	0	0	22,429	0	0	23,116
21	0	0	22,429	0	0	23,116
22	0	0	22,429	0	0	23,116
23	0	0	22,429	0	0	23,116
24	0	0	22,429	0	0	23,116
25	0	0	22,429	0	0	23,116
26	5,495	2,093	20,335	5,495	1,178	21,939
27	0	0	20,335	0	0	21,939
28	5,495	2,093	18,242	5,495	1,178	20,761

continued

Table D.4-14 (*continued*)
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, 6 A.M. (0600)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
29	0	0	18,242	0	0	20,761
30	5,495	2,093	16,149	5,495	1,178	19,584
31	0	0	16,149	0	0	19,584
32	5,495	2,093	14,055	5,495	1,178	18,406
33	0	0	14,055	0	0	18,406
34	1,395	531	13,524	1,395	299	18,107
35	0	0	13,524	0	0	18,107
36	0	0	13,524	0	0	18,107
37	0	0	13,524	0	0	18,107
38	0	0	13,524	0	0	18,107
39	0	0	13,524	0	0	18,107
40	0	0	13,524	0	0	18,107
41	0	0	13,524	0	0	18,107
42	0	0	13,524	0	0	18,107
43	0	0	13,524	0	0	18,107
44	0	0	13,524	0	0	18,107
45	0	0	13,524	0	0	18,107
46	0	0	13,524	0	0	18,107
47	0	0	13,524	0	0	18,107
48	0	0	13,524	0	0	18,107
49	0	0	13,524	0	0	18,107
50	5,495	2,093	11,430	5,495	1,178	16,930
51	0	0	11,430	0	0	16,930
52	5,495	2,093	9,337	5,495	1,178	15,752
53	0	0	9,337	0	0	15,752
54	5,495	2,093	7,244	5,495	1,178	14,575
55	0	0	7,244	0	0	14,575
56	5,495	2,093	5,150	5,495	1,178	13,397
57	0	0	5,150	0	0	13,397
58	1,395	531	4,619	1,395	299	13,098
59	0	0	4,619	0	0	13,098
60	0	0	4,619	0	0	13,098
61	0	0	4,619	0	0	13,098
62	0	0	4,619	0	0	13,098
63	0	0	4,619	0	0	13,098
64	0	0	4,619	0	0	13,098
65	0	0	4,619	0	0	13,098
66	0	0	4,619	0	0	13,098

continued

Table D.4-14 (*continued*)
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, 6 A.M. (0600)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
67	0	0	4,619	0	0	13,098
68	0	0	4,619	0	0	13,098
69	0	0	4,619	0	0	13,098
70	0	0	4,619	0	0	13,098
71	0	0	4,619	0	0	13,098
72	0	0	4,619	0	0	13,098
73	0	0	4,619	0	0	13,098
74	0	0	4,619	0	0	13,098
75	0	0	4,619	0	0	13,098
76	0	0	4,619	0	0	13,098
77	0	0	4,619	0	0	13,098
78	0	0	4,619	0	0	13,098
79	0	0	4,619	0	0	13,098
80	0	0	4,619	0	0	13,098
81	0	0	4,619	0	0	13,098
82	0	0	4,619	0	0	13,098
83	0	0	4,619	0	0	13,098
84	0	0	4,619	0	0	13,098
85	0	0	4,619	0	0	13,098
86	0	0	4,619	0	0	13,098
87	0	0	4,619	0	0	13,098
88	0	0	4,619	0	0	13,098
89	0	0	4,619	0	0	13,098
90	0	0	4,619	0	0	13,098
91	0	0	4,619	0	0	13,098
92	0	0	4,619	0	0	13,098
93	0	0	4,619	0	0	13,098
94	0	0	4,619	0	0	13,098
95	0	0	4,619	0	0	13,098
96	0	0	4,619	0	0	13,098

* Shaded cells denote nighttime hours.

† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

Table D.4-15
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, Noon (1200)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0		24,000	0		24,000
7	0	0	24,000	0	0	24,000
8	0	0	24,000	0	0	24,000
9	0	0	24,000	0	0	24,000
10	0	0	24,000	0	0	24,000
11	0	0	24,000	0	0	24,000
12	0	0	24,000	0	0	24,000
13	0	0	24,000	0	0	24,000
14	0	0	24,000	0	0	24,000
15	0	0	24,000	0	0	24,000
16	0	0	24,000	0	0	24,000
17	0	0	24,000	0	0	24,000
18	0	0	24,000	0	0	24,000
19	4,125	1,571	22,429	4,125	884	23,116
20	5,495	2,093	20,335	5,495	1,178	21,939
21	0	0	20,335	0	0	21,939
22	5,495	2,093	18,242	5,495	1,178	20,761
23	0	0	18,242	0	0	20,761
24	5,495	2,093	16,149	5,495	1,178	19,584
25	0	0	16,149	0	0	19,584
26	5,495	2,093	14,055	5,495	1,178	18,406
27	0	0	14,055	0	0	18,406
28	1,395	531	13,524	1,395	299	18,107
29	0	0	13,524	0	0	18,107
30	0	0	13,524	0	0	18,107
31	0	0	13,524	0	0	18,107
32	0	0	13,524	0	0	18,107
33	0	0	13,524	0	0	18,107
34	0	0	13,524	0	0	18,107
35	0	0	13,524	0	0	18,107
36	0	0	13,524	0	0	18,107
37	0	0	13,524	0	0	18,107
38	0	0	13,524	0	0	18,107
39	0	0	13,524	0	0	18,107
40	0	0	13,524	0	0	18,107
41	0	0	13,524	0	0	18,107
42	0	0	13,524	0	0	18,107
43	5,495	2,093	11,430	5,495	1,178	16,930

continued

Table D.4-15 (*continued*)
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, Noon (1200)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
44	0	0	11,430	0	0	16,930
45	5,495	2,093	9,337	5,495	1,178	15,752
46	0	0	9,337	0	0	15,752
47	5,495	2,093	7,244	5,495	1,178	14,575
48	0	0	7,244	0	0	14,575
49	5,495	2,093	5,150	5,495	1,178	13,397
50	0	0	5,150	0	0	13,397
51	1,395	531	4,619	1,395	299	13,098
52	0	0	4,619	0	0	13,098
53	0	0	4,619	0	0	13,098
54	0	0	4,619	0	0	13,098
55	0	0	4,619	0	0	13,098
56	0	0	4,619	0	0	13,098
57	0	0	4,619	0	0	13,098
58	0	0	4,619	0	0	13,098
59	0	0	4,619	0	0	13,098
60	0	0	4,619	0	0	13,098
61	0	0	4,619	0	0	13,098
62	0	0	4,619	0	0	13,098
63	0	0	4,619	0	0	13,098
64	0	0	4,619	0	0	13,098
65	0	0	4,619	0	0	13,098
66	0	0	4,619	0	0	13,098
67	0	0	4,619	0	0	13,098
68	0	0	4,619	0	0	13,098
69	0	0	4,619	0	0	13,098
70	0	0	4,619	0	0	13,098
71	0	0	4,619	0	0	13,098
72	0	0	4,619	0	0	13,098
73	0	0	4,619	0	0	13,098
74	0	0	4,619	0	0	13,098
75	0	0	4,619	0	0	13,098
76	0	0	4,619	0	0	13,098
77	0	0	4,619	0	0	13,098
78	0	0	4,619	0	0	13,098
79	0	0	4,619	0	0	13,098
80	0	0	4,619	0	0	13,098
81	0	0	4,619	0	0	13,098

continued

Table D.4-15 (*continued*)
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, Noon (1200)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
82	0	0	4,619	0	0	13,098
83	0	0	4,619	0	0	13,098
84	0	0	4,619	0	0	13,098
85	0	0	4,619	0	0	13,098
86	0	0	4,619	0	0	13,098
87	0	0	4,619	0	0	13,098
88	0	0	4,619	0	0	13,098
89	0	0	4,619	0	0	13,098
90	0	0	4,619	0	0	13,098
91	0	0	4,619	0	0	13,098
92	0	0	4,619	0	0	13,098
93	0	0	4,619	0	0	13,098
94	0	0	4,619	0	0	13,098
95	0	0	4,619	0	0	13,098
96	0	0	4,619	0	0	13,098

* Shaded cells denote nighttime hours.

† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

Table D.4-16
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, 6 P.M. (1800)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
0–6	0		24,000	0		24,000
7	0	0	24,000	0	0	24,000
8	0	0	24,000	0	0	24,000
9	0	0	24,000	0	0	24,000
10	0	0	24,000	0	0	24,000
11	0	0	24,000	0	0	24,000
12	0	0	24,000	0	0	24,000
13	4,125	1,571	22,429	4,125	884	23,116
14	5,495	2,093	20,335	5,495	1,178	21,939
15	0	0	20,335	0	0	21,939
16	5,495	2,093	18,242	5,495	1,178	20,761
17	0	0	18,242	0	0	20,761
18	5,495	2,093	16,149	5,495	1,178	19,584

continued

Table D.4-16 (*continued*)
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, 6 P.M. (1800)

	80% Effectiveness			45% Effectiveness		
Hours After Spill*	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†	Dispersant Applied (gal)	Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	Oil Remaining on Surface of Water at End of Each Hour†
19	0	0	16,149	0	0	19,584
20	5,495	2,093	14,055	5,495	1,178	18,406
21	0	0	14,055	0	0	18,406
22	1,395	531	13,524	1,395	299	18,107
23	0	0	13,524	0	0	18,107
24	0	0	13,524	0	0	18,107
25	0	0	13,524	0	0	18,107
26	0	0	13,524	0	0	18,107
27	0	0	13,524	0	0	18,107
28	0	0	13,524	0	0	18,107
29	0	0	13,524	0	0	18,107
30	0	0	13,524	0	0	18,107
31	0	0	13,524	0	0	18,107
32	0	0	13,524	0	0	18,107
33	0	0	13,524	0	0	18,107
34	0	0	13,524	0	0	18,107
35	0	0	13,524	0	0	18,107
36	0	0	13,524	0	0	18,107
37	0	0	13,524	0	0	18,107
38	5,495	2,093	11,430	5,495	1,178	16,930
39	0	0	11,430	0	0	16,930
40	5,495	2,093	9,337	5,495	1,178	15,752
41	0	0	9,337	0	0	15,752
42	5,495	2,093	7,244	5,495	1,178	14,575
43	0	0	7,244	0	0	14,575
44	5,495	2,093	5,150	5,495	1,178	13,397
45	0	0	5,150	0	0	13,397
46	1,395	531	4,619	1,395	299	13,098
47	0	0	4,619	0	0	13,098
48	0	0	4,619	0	0	13,098
49	0	0	4,619	0	0	13,098
50	0	0	4,619	0	0	13,098
51	0	0	4,619	0	0	13,098
52	0	0	4,619	0	0	13,098
53	0	0	4,619	0	0	13,098
54	0	0	4,619	0	0	13,098
55	0	0	4,619	0	0	13,098
56	0	0	4,619	0	0	13,098
57	0	0	4,619	0	0	13,098

continued

Table D.4-16 (*continued*)
Dispersant Use on a 40,000-bbl Spill in a Non–Gulf of Mexico Region, 6 P.M. (1800)

Hours After Spill*	80% Effectiveness: Dispersant Applied (gal)	80% Effectiveness: Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	80% Effectiveness: Oil Remaining on Surface of Water at End of Each Hour†	45% Effectiveness: Dispersant Applied (gal)	45% Effectiveness: Estimated Quantity of Oil Dispersed in Water Column per Application (bbl)	45% Effectiveness: Oil Remaining on Surface of Water at End of Each Hour†
58	0	0	4,619	0	0	13,098
59	0	0	4,619	0	0	13,098
60	0	0	4,619	0	0	13,098
61	0	0	4,619	0	0	13,098
62	0	0	4,619	0	0	13,098
63	0	0	4,619	0	0	13,098
64	0	0	4,619	0	0	13,098
65	0	0	4,619	0	0	13,098
66	0	0	4,619	0	0	13,098
67	0	0	4,619	0	0	13,098
68	0	0	4,619	0	0	13,098
69	0	0	4,619	0	0	13,098
70	0	0	4,619	0	0	13,098
71	0	0	4,619	0	0	13,098
72	0	0	4,619	0	0	13,098
73	0	0	4,619	0	0	13,098
74	0	0	4,619	0	0	13,098
75	0	0	4,619	0	0	13,098
76	0	0	4,619	0	0	13,098
77	0	0	4,619	0	0	13,098
78	0	0	4,619	0	0	13,098
79	0	0	4,619	0	0	13,098
80	0	0	4,619	0	0	13,098
81	0	0	4,619	0	0	13,098
82	0	0	4,619	0	0	13,098
83	0	0	4,619	0	0	13,098
84	0	0	4,619	0	0	13,098
85	0	0	4,619	0	0	13,098
86	0	0	4,619	0	0	13,098
87	0	0	4,619	0	0	13,098
88	0	0	4,619	0	0	13,098
89	0	0	4,619	0	0	13,098
90	0	0	4,619	0	0	13,098
91	0	0	4,619	0	0	13,098
92	0	0	4,619	0	0	13,098
93	0	0	4,619	0	0	13,098
94	0	0	4,619	0	0	13,098
95	0	0	4,619	0	0	13,098
96	0	0	4,619	0	0	13,098

* Shaded cells denote nighttime hours.

† 40,000 bbl spilled; 16,000 bbl natural dispersion; 24,000 bbl for treatment/removal at hour 6.

D.5. DATA DESCRIPTION—OIL SPILL AERIAL TRACKING

- Aerial tracking is not shown separately. It is a necessary part of all response operations and is assumed to be critical to, but not increase, the efficiencies reported in the Tables D.2-1 through -4, D.3-1 through -4, and D.4-1 through -16.
- Mechanical recovery, *in situ* burning, and chemical dispersion all require continuous aerial tracking to direct response resources to and keep them in the thickest parts of the oil as it spreads over the surface of the water.
- These resources were previously provided on an ad hoc basis by either government or industry.

This page intentionally left blank

APPENDIX E
HISTORICAL OIL SPILL DATA SET, 1993–1998

E.1. POTENTIAL FOR MECHANICAL RECOVERY, CHEMICAL DISPERSION, AND *IN SITU* BURNING

Of the 231 oil spills in the historical oil spill data set (USCG, 1999), there were 79 spills of at least 1,000 gallons (gal) and at a distance of more than 3 nautical miles (nm) from shore (Table E.1-1), with a combined discharge of 437,553 gal. On average, there were 13.2 spills per year, with an average discharge of 5,539 gal.

Table E.1-1
Historical Oil Spill Data for Potential Mechanical Recovery, Chemical Dispersion, and *In Situ* Burning in All Regions for Spills of ≥ 1,000 gal, ≥ 3 nm from Shore

Vessel Name	Region	Spill Date	Spill Amount (gal)	Substance Spilled	Wind Speed (kt)*	Depth (ft)*	API° Gravity*
L'ARCHE DADONAI	Gulf of Mexico	02/20/93	1,500	Waste/lube oil	14	2,146	22
SEA-LAND HAWAII	Oceania	03/13/93	25,200	Waste/lube oil	16	14,120	22
MISS RACHEL	Gulf of Mexico	03/16/93	2,500	Diesel	20	172	39
Unknown vessel	Gulf of Mexico	04/16/93	1,000	Crude oil	12	406	30–38
H.O.S. NASHUA	Gulf of Mexico	05/08/93	1,915	Diesel	12	225	39
CANDY SUPPLIER	Gulf of Mexico	06/11/93	2,000	Diesel	9	112	39
SEAVENTURE	Pacific	06/13/93	2,000	Diesel	10	510	39
CONSTITUTION	Oceania	06/14/93	1,000	No.6 fuel oil	10	13,571	14
USS JASON AR-8	Pacific	06/18/93	5,000	Waste/lube oil	8	5,044	22
NYHERON	Gulf of Mexico	07/31/93	2,100	Crude oil	10	106	30–38
SUN TIDE	Alaska	08/23/93	6,000	Diesel	11	3	39
RED SEAGULL	Gulf of Mexico	09/02/93	6,720	Kuwait crude oil	11	83	31
SEALIFT ANTARCTIC	Oceania	10/06/93	1,680	Diesel	18	15,261	39

continued

Table E.1-1 (*continued*)
Historical Oil Spill Data for Potential Mechanical Recovery, Chemical Dispersion, and *In Situ* Burning in All Regions for Spills of ≥ 1,000 gal, ≥ 3 nm from Shore

Vessel Name	Region	Spill Date	Spill Amount (gal)	Substance Spilled	Wind Speed (kt)*	Depth (ft)*	API° Gravity*
ALLEY CAT II	Gulf of Mexico	11/08/93	2,500	Diesel	12	79	39
ANTARES	Gulf of Mexico	12/29/93	5,000	No.6 fuel oil	12	79	14
LADY SELKET	Alaska	02/06/94	1,500	Diesel	25	456	39
HUMBER ARM	Atlantic-Caribbean	03/19/94	1,050	Motor oil	12	97	29
GENESIS	Atlantic-Caribbean	03/29/94	1,000	Diesel	9	35	39
GAMBLER	Atlantic-Caribbean	04/03/94	1,100	No.2 fuel oil	25	140	32
SAN ANTONIO II	Atlantic-Caribbean	04/22/94	3,000	Vegetable oil	15	1,803	3
CAPT. JAMES II	Atlantic-Caribbean	05/21/94	6,000	Diesel	10	80	39
HOLOKAI	Oceania	06/08/94	3,200	Diesel	15	3,000	39
NIKATOR/ BARGE 101	Atlantic-Caribbean	06/28/94	2,573	Waste/lube oil	5	11,115	22
Unknown vessel	Oceania	08/19/94	1,000	Waste/lube oil	7	3,051	22
CRACKER JACK	Gulf of Mexico	08/30/94	3,000	No.2 fuel oil	9	279	32
ISLAND ENTERPRISE	Alaska	09/15/94	12,705	Diesel	40–50	263	39
FREDA M	Pacific	10/29/94	1,500	Diesel	30	5,746	39
FIVE PRINCESSES	Gulf of Mexico	10/30/94	1,000	Diesel	10	24	39
BAYOU GOLD	Gulf of Mexico	11/03/94	1,500	Crude oil	25	< 10	30–38
BAYOU PRINCESS	Gulf of Mexico	11/05/94	6,000	Diesel	14	38	39
BEAN BOOSTER 24	Atlantic-Caribbean	11/24/94	2,000	No.6 fuel oil	40	81	14
KANDI SUE	Gulf of Mexico	12/10/94	2,500	Diesel	25–30	65	39
MINTROP	Gulf of Mexico	01/05/95	2,200	No.1 fuel oil	14	481	45
SKAUBAY/ BERGE BANKER	Gulf of Mexico	02/05/95	37,716	No.6 fuel oil	10–15	113	14
FLORIDA EXPRESS	Alaska	02/27/95	8,400	No.6 fuel oil	10	93	14
ISLANDER IV	Gulf of Mexico	04/17/95	1,500	Diesel	14	79	39
CAPT. KELVIN	Atlantic-Caribbean	04/21/95	1,000	Diesel	7	72	39
H.O.S. DETERMINE	Gulf of Mexico	04/21/95	1,100	Diesel	12	351	39
CORDOVA	Alaska	05/06/95	1,600	Diesel	20–25	232	39
Unknown vessel	Atlantic-Caribbean	05/10/95	1,940	JP-8	7	X	43
SHEENA MARIE	Atlantic-Caribbean	06/18/95	3,000	Diesel	12	47	39
INTERSTATE 138	Alaska	07/01/95	92,610	No.6 fuel oil	9	58	14
ENIF	Gulf of Mexico	07/01/95	1,000	No.2 fuel oil	6	3,615	32
MARJORIE B. MCALLISTER	Atlantic-Caribbean	08/02/95	25,000	Diesel	7	234	39
MCDERMOTT DERRICK BARGE NO. 50	Gulf of Mexico	08/18/95	3,225	Crude oil/ hydraulic	8	1,896	30–38
ENSCO EXPLORER	Gulf of Mexico	08/24/95	1,554	Diesel	8	39	39

continued

Table E.1-1 (*continued*)
Historical Oil Spill Data for Potential Mechanical Recovery, Chemical Dispersion, and *In Situ* Burning in All Regions for Spills of ≥ 1,000 gal, ≥ 3 nm from Shore

Vessel Name	Region	Spill Date	Spill Amount (gal)	Substance Spilled	Wind Speed (kt)*	Depth (ft)*	API° Gravity*
ROWAN GORILLA IV	Gulf of Mexico	11/03/95	3,722	Diesel	30	376	39
ALASKAN SEA CURE	Pacific	11/30/95	1,500	Waste/lube oil	7	2,970	22
ERIE	Atlantic-Caribbean	12/10/95	6,400	Diesel	35	9,452	39
WAHOO	Gulf of Mexico	03/26/96	4,000	Diesel	35	31	39
THAI DUONG	Gulf of Mexico	05/19/96	2,800	Diesel	11	15	39
LEONARD	Atlantic-Caribbean	6/17/96	2,000	No.2-D fuel oil	10	1,300	35
JOAN MORAN	Gulf of Mexico	08/02/96	1,000	Diesel	8	119	39
CAPTAIN BEAR	Gulf of Mexico	08/21/96	1,500	No.2-D fuel oil	8	135	35
MI HIJO	Gulf of Mexico	10/10/96	1,800	Diesel	12	105	39
GILBERT TIDE	Gulf of Mexico	10/27/96	1,900	Diesel	13	142	39
RICHMOND	Gulf of Mexico	11/15/96	1,200	Diesel	11	16	39
BALDER	Gulf of Mexico	12/31/96	2,600	Hydraulic fluid or oil	18	754	22
ROSIE G	Alaska	01/30/97	16,000	Diesel	20–25	4,578	39
HAUR CHUEN NO.3	Oceania	04/04/97	1,000	Waste/lube oil	7	2,451	22
PENNY'S PRIDE	Atlantic-Caribbean	05/28/97	1,000	Diesel	9	11	39
KELSTAR	Pacific	06/23/97	2,560	No.2-D fuel oil	6	793	35
ROWAN ALASKA	Gulf of Mexico	07/11/97	1,218	No.2-D fuel oil	8	142	35
NCC TIHAMAH	Gulf of Mexico	07/20/97	7,500	Diesel	9	40	39
DERICK BARGE 50	Gulf of Mexico	08/12/97	5,000	Lube oil	7	1,910	22
CELIA M	Gulf of Mexico	10/21/97	5,000	Diesel	10	40	39
OCEAN NUGGET	Gulf of Mexico	11/10/97	2,000	Diesel	14	156	39
LINDA "B"	Atlantic-Caribbean	11/29/97	1,800	Diesel	6	86	39
EAGLE LYRA	Gulf of Mexico	01/02/98	1,680	Crude oil	9	95	30–38
MISS STEPHANIE	Gulf of Mexico	01/07/98	10,000	Diesel	11	27	39
RED SEAGULL	Oceania	01/23/98	21,000	Med. Arabian crude oil	9	85	30
ADRIATIC SEA	Gulf of Mexico	01/23/98	1,500	Hydraulic fluid or oil	7	15,123	22
ROSELLEN	Atlantic-Caribbean	02/03/98	14,300	Vegetable oil	X	X	3
GATE DANCER	Gulf of Mexico	03/25/98	6,115	Lube oil	10	64	22
NAVY S-3	Pacific	03/31/98	1,470	JP-5	8	X	41
IDLEWILD	Gulf of Mexico	05/25/98	1,500	No.2-D fuel oil	15	161	35
JUAN GABRIEL	Atlantic-Caribbean	06/22/98	4,000	Diesel	2–3	33	39
Unknown vessel	Gulf of Mexico	07/26/98	2,100	Crude oil	7	23	30–38
CINDY	Atlantic-Caribbean	08/04/98	1,800	No.2 fuel oil	8	13	32

Source: Adapted from USCG, 1999.
Note: X, unknown.
* Rounded to the nearest whole number.

E.2. POTENTIAL FOR MECHANICAL RECOVERY

Of the 79 oil spills listed in Table E.1-1, there were 56 spills (Table E.2-1), with a combined discharge of 212,020 gal, in which mechanical recovery could have been a response option. On average, there were 9.3 spills per year, with an average discharge of 3,786 gal, in which mechanical recovery could have been a response option.

Table E.2-1
Historical Oil Spill Data for Potential Mechanical Recovery in All Regions for Spills of ≥ 1,000 gal, ≥ 3 nm from Shore

Vessel Name	Region	Spill Date	Spill Amount (gal)	Substance Spilled	Wind Speed (kt)*	Depth (ft)*	API° Gravity*
L'ARCHE DADONAI	Gulf of Mexico	02/20/93	1,500	Waste/lube oil	14	2,146	22
SEA-LAND HAWAII	Oceania	03/13/93	25,200	Waste/lube oil	16	14,120	22
Unknown vessel	Gulf of Mexico	04/16/93	1,000	Crude oil	12	406	30–38
H.O.S. NASHUA	Gulf of Mexico	05/08/93	1,915	Diesel	12	225	39
CANDY SUPPLIER	Gulf of Mexico	06/11/93	2,000	Diesel	9	112	39
SEAVENTURE	Pacific	06/13/93	2,000	Diesel	10	510	39
USS JASON AR-8	Pacific	06/18/93	5,000	Waste/lube oil	8	5,044	22
NYHERON	Gulf of Mexico	07/31/93	2,100	Crude oil	10	106	30–38
SUN TIDE	Alaska	08/23/93	6,000	Diesel	11	3	39
RED SEAGULL	Gulf of Mexico	09/02/93	6,720	Kuwait crude oil	11	83	31
ALLEY CAT II	Gulf of Mexico	11/08/93	2,500	Diesel	12	79	39
HUMBER ARM	Atlantic-Caribbean	03/19/94	1,050	Motor oil	12	97	29
GENESIS	Atlantic-Caribbean	03/29/94	1,000	Diesel	9	35	39
CAPT. JAMES II	Atlantic-Caribbean	05/21/94	6,000	Diesel	10	80	39
HOLOKAI	Oceania	06/08/94	3,200	Diesel	15	3,000	39
NIKATOR/ BARGE 101	Atlantic-Caribbean	06/28/94	2,573	Waste/lube oil	5	11,115	22
Unknown vessel	Oceania	08/19/94	1,000	Waste/lube oil	7	3,051	22
CRACKER JACK	Gulf of Mexico	08/30/94	3,000	No.2 fuel oil	9	279	32
FIVE PRINCESSES	Gulf of Mexico	10/30/94	1,000	Diesel	10	24	39
BAYOU PRINCESS	Gulf of Mexico	11/05/94	6,000	Diesel	14	38	39
ISLANDER IV	Gulf of Mexico	04/17/95	1,500	Diesel	14	79	39
CAPT. KELVIN	Atlantic-Caribbean	04/21/95	1,000	Diesel	7	72	39
H.O.S. DETERMINE	Gulf of Mexico	04/21/95	1,100	Diesel	12	351	39
Unknown vessel	Atlantic-Caribbean	05/10/95	1,940	JP-8	7	X	43
SHEENA MARIE	Atlantic-Caribbean	06/18/95	3,000	Diesel	12	47	39
ENIF	Gulf of Mexico	07/01/95	1,000	No.2 fuel oil	6	3,615	32
MARJORIE B. MCALLISTER	Atlantic-Caribbean	08/02/95	25,000	Diesel	7	234	39
MCDERMOTT DERRICK BARGE NO. 50	Gulf of Mexico	08/18/95	3,225	Crude oil/ hydraulic	8	1,896	30–38

continued

Table E.2-1 (*continued*)
Historical Oil Spill Data for Potential Mechanical Recovery in All Regions for Spills of ≥ 1,000 gal, ≥ 3 nm from Shore

Vessel Name	Region	Spill Date	Spill Amount (gal)	Substance Spilled	Wind Speed (kt)*	Depth (ft)*	API° Gravity*
ENSCO EXPLORER	Gulf of Mexico	08/24/95	1,554	Diesel	8	39	39
ALASKAN SEA CURE	Pacific	11/30/95	1,500	Waste/lube oil	7	2,970	22
THAI DUONG	Gulf of Mexico	05/19/96	2,800	Diesel	11	15	39
LEONARD	Atlantic-Caribbean	6/17/96	2,000	No.2-D fuel oil	10	1,300	35
JOAN MORAN	Gulf of Mexico	08/02/96	1,000	Diesel	8	119	39
CAPTAIN BEAR	Gulf of Mexico	08/21/96	1,500	No.2-D fuel oil	8	135	35
MI HIJO	Gulf of Mexico	10/10/96	1,800	Diesel	12	105	39
GILBERT TIDE	Gulf of Mexico	10/27/96	1,900	Diesel	13	142	39
RICHMOND	Gulf of Mexico	11/15/96	1,200	Diesel	11	16	39
HAUR CHUEN NO.3	Oceania	04/04/97	1,000	Waste/lube oil	7	2,451	22
PENNY'S PRIDE	Atlantic-Caribbean	05/28/97	1,000	Diesel	9	11	39
KELSTAR	Pacific	06/23/97	2,560	No.2-D fuel oil	6	793	35
ROWAN ALASKA	Gulf of Mexico	07/11/97	1,218	No.2-D fuel oil	8	142	35
NCC TIHAMAH	Gulf of Mexico	07/20/97	7,500	Diesel	9	40	39
DERICK BARGE 50	Gulf of Mexico	08/12/97	5,000	Lube oil	7	1,910	22
CELIA M	Gulf of Mexico	10/21/97	5,000	Diesel	10	40	39
OCEAN NUGGET	Gulf of Mexico	11/10/97	2,000	Diesel	14	156	39
LINDA "B"	Atlantic-Caribbean	11/29/97	1,800	Diesel	6	86	39
EAGLE LYRA	Gulf of Mexico	01/02/98	1,680	Crude oil	9	95	30–38
MISS STEPHANIE	Gulf of Mexico	01/07/98	10,000	Diesel	11	27	39
RED SEAGULL	Oceania	01/23/98	21,000	Med. Arabian crude oil	9	85	30
ADRIATIC SEA	Gulf of Mexico	01/23/98	1,500	Hydraulic fluid or oil	7	15,123	22
GATE DANCER	Gulf of Mexico	03/25/98	6,115	Lube oil	10	64	22
NAVY S-3	Pacific	03/31/98	1,470	JP-5	8	X	41
IDLEWILD	Gulf of Mexico	05/25/98	1,500	No.2-D fuel oil	15	161	35
JUAN GABRIEL	Atlantic-Caribbean	06/22/98	4,000	Diesel	2–3	33	39
Unknown vessel	Gulf of Mexico	07/26/98	2,100	Crude oil	7	23	30–38
CINDY	Atlantic-Caribbean	08/04/98	1,800	No.2 fuel oil	8	13	32

Source: Adapted from USCG, 1999.

Note: X, unknown.

* Rounded to the nearest whole number.

E.3. POTENTIAL FOR CHEMICAL DISPERSION

Of the 79 oil spills listed in Table E.1-1, there were 13 spills (Table E.3-1), with a combined discharge of 57,807 gal, in which only chemical dispersion could have been a response option. On average, there were 2.2 spills per year, with an average discharge of 4,447 gal, in which only dispersant use could have been a response option.

Table E.3-1
Historical Oil Spill Data for Potential Chemical Dispersion Only in All Regions for Spills of ≥ 1,000 gal, ≥ 3 nm from Shore

Vessel Name	Region	Spill Date	Spill Amount (gal)	Substance Spilled	Wind Speed (kt)*	Depth (ft)*	API° Gravity*
MISS RACHEL	Gulf of Mexico	03/16/93	2,500	Diesel	20	172	39
SEALIFT ANTARCTIC	Oceania	10/06/93	1,680	Diesel	18	15,261	39
LADY SELKET	Alaska	02/06/94	1,500	Diesel	25	456	39
GAMBLER	Atlantic-Caribbean	04/03/94	1,100	No.2 fuel oil	25	140	32
ISLAND ENTERPRISE	Alaska	09/15/94	12,705	Diesel	40–50	263	39
FREDA M	Pacific	10/29/94	1,500	Diesel	30	5,746	39
KANDI SUE	Gulf of Mexico	12/10/94	2,500	Diesel	25–30	65	39
CORDOVA	Alaska	05/06/95	1,600	Diesel	20–25	232	39
ROWANGORILLAIV	Gulf of Mexico	11/03/95	3,722	Diesel	30	376	39
ERIE	Atlantic-Caribbean	12/10/95	6,400	Diesel	35	9,452	39
WAHOO	Gulf of Mexico	03/26/96	4,000	Diesel	35	31	39
BALDER	Gulf of Mexico	12/31/96	2,600	Hydraulic fluid or oil	18	754	22
ROSIE G	Alaska	01/30/97	16,000	Diesel	20–25	4,578	39

Source: Adapted from USCG, 1999.

* Rounded to the nearest whole number.

Based on the Regulatory Analysis for Changes to Vessel and Facility Response Plans (USCG, 2008) estimate that a spill size of 1,680 gal (40 bbl) is the lower threshold at which dispersant operations might be considered practicable, of the 79 oil spills listed in Table E.1-1, there were 52 spills (Table E.3-2), with a combined discharge of 403,761 gal, in which dispersant use could have been a response option. On average, there were 8.7 spills per year, with an average discharge of 7,765 gal, in which dispersant use could have been a response option.

Table E.3-2
Historical Oil Spill Data for Potential Chemical Dispersion in All Regions for Spills of ≥ 1,680 gal*, ≥ 3 nm from Shore

Vessel Name	Region	Spill Date	Spill Amount (gal)	Substance Spilled	Wind Speed (kt)†	Depth (ft)†	API° Gravity†
SEA-LAND HAWAII	Oceania	03/13/93	25,200	Waste/lube oil	16	14,120	22
MISS RACHEL	Gulf of Mexico	03/16/93	2,500	Diesel	20	172	39
H.O.S. NASHUA	Gulf of Mexico	05/08/93	1,915	Diesel	12	225	39
CANDY SUPPLIER	Gulf of Mexico	06/11/93	2,000	Diesel	9	112	39
SEAVENTURE	Pacific	06/13/93	2,000	Diesel	10	510	39
USS JASON AR-8	Pacific	06/18/93	5,000	Waste/lube oil	8	5,044	22
NYHERON	Gulf of Mexico	07/31/93	2,100	Crude oil	10	106	30–38
SUN TIDE	Alaska	08/23/93	6,000	Diesel	11	3	39
RED SEAGULL	Gulf of Mexico	09/02/93	6,720	Kuwait crude oil	11	83	31
SEALIFT ANTARCTIC	Oceania	10/06/93	1,680	Diesel	18	15,261	39
ALLEY CAT II	Gulf of Mexico	11/08/93	2,500	Diesel	12	79	39
ANTARES	Gulf of Mexico	12/29/93	5,000	No.6 fuel oil	12	79	14
SAN ANTONIO II	Atlantic-Caribbean	04/22/94	3,000	Vegetable oil	15	1,803	3
CAPT. JAMES II	Atlantic-Caribbean	05/21/94	6,000	Diesel	10	80	39
HOLOKAI	Oceania	06/08/94	3,200	Diesel	15	3,000	39
NIKATOR/ BARGE 101	Atlantic-Caribbean	06/28/94	2,573	Waste/lube oil	5	11,115	22
CRACKER JACK	Gulf of Mexico	08/30/94	3,000	No.2 fuel oil	9	279	32
ISLAND ENTERPRISE	Alaska	09/15/94	12,705	Diesel	40–50	263	39
BAYOU PRINCESS	Gulf of Mexico	11/05/94	6,000	Diesel	14	38	39
BEAN BOOSTER 24	Atlantic-Caribbean	11/24/94	2,000	No.6 fuel oil	40	81	14
KANDI SUE	Gulf of Mexico	12/10/94	2,500	Diesel	25–30	65	39
MINTROP	Gulf of Mexico	01/05/95	2,200	No.1 fuel oil	14	481	45
SKAUBAY/ BERGE BANKER	Gulf of Mexico	02/05/95	37,716	No.6 fuel oil	10–15	113	14
FLORIDA EXPRESS	Alaska	02/27/95	8,400	No.6 fuel oil	10	93	14
Unknown vessel	Atlantic-Caribbean	05/10/95	1,940	JP-8	7	X	43
SHEENA MARIE	Atlantic-Caribbean	06/18/95	3,000	Diesel	12	47	39
INTERSTATE 138	Alaska	07/01/95	92,610	No.6 fuel oil	9	58	14
MARJORIE B. MCALLISTER	Atlantic-Caribbean	08/02/95	25,000	Diesel	7	234	39
MCDERMOTT DERRICK BARGE NO. 50	Gulf of Mexico	08/18/95	3,225	Crude oil/ hydraulic	8	1,896	30–38
ROWAN GORILLA IV	Gulf of Mexico	11/03/95	3,722	Diesel	30	376	39
ERIE	Atlantic-Caribbean	12/10/95	6,400	Diesel	35	9,452	39
WAHOO	Gulf of Mexico	03/26/96	4,000	Diesel	35	31	39
THAI DUONG	Gulf of Mexico	05/19/96	2,800	Diesel	11	15	39

continued

Table E.3-2 (*continued*)
Historical Oil Spill Data for Potential Chemical Dispersion in All Regions for Spills of ≥ 1,680 gal*, ≥ 3 nm from Shore

Vessel Name	Region	Spill Date	Spill Amount (gal)	Substance Spilled	Wind Speed (kt)†	Depth (ft)†	API° Gravity†
LEONARD	Atlantic-Caribbean	6/17/96	2,000	No.2-D fuel oil	10	1,300	35
MI HIJO	Gulf of Mexico	10/10/96	1,800	Diesel	12	105	39
GILBERT TIDE	Gulf of Mexico	10/27/96	1,900	Diesel	13	142	39
BALDER	Gulf of Mexico	12/31/96	2,600	Hydraulic fluid or oil	18	754	22
ROSIE G	Alaska	01/30/97	16,000	Diesel	20–25	4,578	39
KELSTAR	Pacific	06/23/97	2,560	No.2-D fuel oil	6	793	35
NCC TIHAMAH	Gulf of Mexico	07/20/97	7,500	Diesel	9	40	39
DERICK BARGE 50	Gulf of Mexico	08/12/97	5,000	Lube oil	7	1,910	22
CELIA M	Gulf of Mexico	10/21/97	5,000	Diesel	10	40	39
OCEAN NUGGET	Gulf of Mexico	11/10/97	2,000	Diesel	14	156	39
LINDA "B"	Atlantic-Caribbean	11/29/97	1,800	Diesel	6	86	39
EAGLE LYRA	Gulf of Mexico	01/02/98	1,680	Crude oil	9	95	30–38
MISS STEPHANIE	Gulf of Mexico	01/07/98	10,000	Diesel	11	27	39
RED SEAGULL	Oceania	01/23/98	21,000	Med. Arabian crude oil	9	85	30
ROSELLEN	Atlantic-Caribbean	02/03/98	14,300	Vegetable oil	X	X	3
GATE DANCER	Gulf of Mexico	03/25/98	6,115	Lube oil	10	64	22
JUAN GABRIEL	Atlantic-Caribbean	06/22/98	4,000	Diesel	2–3	33	39
Unknown vessel	Gulf of Mexico	07/26/98	2,100	Crude oil	7	23	30–38
CINDY	Atlantic-Caribbean	08/04/98	1,800	No.2 fuel oil	8	13	32

Source: Adapted from USCG, 1999.

Note: X, unknown.

* Estimated spill size for practicable dispersant use from USCG, 2002.

† Rounded to the nearest whole number.

E.4. POTENTIAL FOR *IN SITU* BURNING

As noted in Chapter 2 of this Programmatic Environmental Impact Statement (PEIS), of the 79 oil spills listed in Table E.1-1, there were no spills in which *in situ* burning was feasible when mechanical recovery was not. However, based on the *Regulatory Analysis for Changes to Vessel and Facility Response Plans* (USCG, 2008) estimate that a spill size of 23,646 gal (563 bbl) is the lower threshold at which *in situ* burn operations might be considered practicable, of the 79 oil spills listed in Table E.1-1, there were four spills (Table E.4-1), with a combined discharge of 180,526 gal, in which *in situ* burning could have been a response option. On average, there were 0.7 spills per year, with an average discharge of 45,132 gal, in which *in situ* burning could have been a response option.

Table E.4-1
Historical Oil Spill Data for Potential *In Situ* Burning in All Regions for Spills of ≥ 23,646 gal*, ≥ 3 nm from Shore

Vessel Name	Region	Spill Date	Spill Amount (gal)	Substance Spilled	Wind Speed (kt)†	Depth (ft)†	API° Gravity†	Pour Point (°F)†
SEA-LAND HAWAII	Oceania	03/13/93	25,200	Waste/lube oil	16	14,120	22	5–19
SKAUBAY/ BERGE BANKER	Gulf of Mexico	02/05/95	37,716	No.6 fuel oil	10–15	113	14	5–25
INTERSTATE 138	Alaska	07/01/95	92,610	No.6 fuel oil	9	58	14	5–25
MARJORIE B. MCALLISTER	Atlantic-Caribbean	08/02/95	25,000	Diesel	7	234	39	–29–0

Source: Adapted from USCG, 1999.

* Estimated spill size for practicable dispersant use from USCG, 2002.

† Rounded to the nearest whole number.

E.5. POTENTIAL FOR NATURAL REMOVAL

Of the 79 oil spills listed in Table E.1-1, there were 10 spills (Table E.5-1), with a combined discharge of 167,726 gal, in which natural removal could have been a response option. On average, there were 1.7 spills per year, with an average discharge of 27,954 gal, in which natural removal could have been a response option.

Table E.5-1
Historical Oil Spill Data for Potential Natural Removal in All Regions for Spills of ≥ 1,000 gal, ≥ 3 nm from Shore

Vessel Name	Region	Spill Date	Spill Amount (gal)	Substance Spilled	Wind Speed (kt)*	Depth (ft)*	API° Gravity*
CONSTITUTION	Oceania	06/14/93	1,000	No.6 fuel oil	10	13,571	14
ANTARES	Gulf of Mexico	12/29/93	5,000	No.6 fuel oil	12	79	14
SAN ANTONIO II	Atlantic-Caribbean	04/22/94	3,000	Vegetable oil	15	1,803	3
BAYOU GOLD	Gulf of Mexico	11/03/94	1,500	Crude oil	25	< 10	30–38
BEAN BOOSTER 24	Atlantic-Caribbean	11/24/94	2,000	No.6 fuel oil	40	81	14
MINTROP	Gulf of Mexico	01/05/95	2,200	No.1 fuel oil	14	481	45
SKAUBAY/ BERGE BANKER	Gulf of Mexico	02/05/95	37,716	No.6 fuel oil	10–15	113	14
FLORIDA EXPRESS	Alaska	02/27/95	8,400	No.6 fuel oil	10	93	14
INTERSTATE 138	Alaska	07/01/95	92,610	No.6 fuel oil	9	58	14
ROSELLEN	Atlantic-Caribbean	02/03/98	14,300	Vegetable oil	X	X	3

Source: Adapted from USCG, 1999.

Note: X, unknown.

* Rounded to the nearest whole number.

This page intentionally left blank

APPENDIX F
AFFECTED ENVIRONMENT SUPPLEMENTARY INFORMATION

F.1. Introduction

Table F.1-1
Federal Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Federal Standards*,†,‡	Secondary Federal Standards*,†,§	CA Standards*,‖	FL Standards#
Ozone (O_3)	1 hr	0.12 ppm (235 μg/m³)	0.12 ppm	0.09 ppm (180 μg/m³)	
	8 hr**	0.08 ppm (157 μg/m³)	0.08 ppm		
Carbon monoxide (CO)	8 hr	9.0 ppm (10 mg/m³)		20 ppm (23 mg/m³)	
	1 hr	35.0 ppm (40 mg/m³)			
Nitrogen dioxide (NO_2)	Annual mean	100 μg/m³ (0.053 ppm)	100 μg/m³	0.25 ppm (470 μg/m³)	
Sulfur dioxide (SO_2)	Annual mean	80 μg/m³ (0.03 ppm)		0.25 ppm (655 μg/m³)	60 μg/m³ 0.02ppm
	24 hr	365 μg/m³ (0.14 ppm)			260 μg/m³ 0.1ppm
	3 hr		1,300 μg/m³ (0.5 ppm)		1,300 μg/m³ (0.5 ppm)
Suspended particulate matter (PM10)	Annual mean	50 μg/m³	50 μg/m³	0.04 ppm (104 μg/m³)	
	24 hr	150 μg/m³	150 μg/m³	50 μg/m³	
Suspended particulate matter (PM2.5)	Annual mean**	15 μg/m³	15 μg/m³		
	24 hr**	65 μg/m³	65 μg/m³		
Lead (Pb)	30-d average per calendar quarter	1.5 μg/m³	1.5 μg/m³	1.5 μg/m³	

continued

Table F.1-1 (*continued*)
Federal Ambient Air Quality Standards

Source: USEPA, 2000; Florida Standards: FDEP, 2004.

* Federal standards, other than ozone and those based on annual averages or geometric means, are not to be exceeded more than once per year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one.

† Federal primary standard is the level necessary to protect the public health with an adequate margin of safety.

‡ Federal secondary standard is the level necessary to protect public from known/anticipated pollutant adverse effects.

§ Applies only at locations where the state's standard for ozone and/or total suspended particulate matter are violated.

‖ Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based on a reference temperature of 25°C and a reference pressure of 760 mm Hg (1013.2 millibars); parts per million (ppm) in this table refers to ppm by volume, or micromoles per mole of gas.

Florida made sulfur dioxide emission levels more restrictive than the federal standard.

** The ozone 8-hr and PM2.5 standards are included for information only. A 1999 federal court ruling blocked implementation of these standards, which the U.S. Environmental Protection Agency (USEPA) proposed in 1997. USEPA has asked the U.S. Supreme Court to reconsider that decision.

F.2. ATLANTIC REGION

Table F.2-1
Nonendangered Marine Mammals of the Atlantic Region

Group	Scientific Name	Common Name
Cetaceans	*Delphinapterus leucas*	Beluga whale
	Balaenoptera acutorostrata	Minke whale
	Mesoplodon and *Ziphius* spp.	Beaked whale species
	Globicephala melaena	Long-finned pilot whale
	Globicephala macrorhynchus	Short-finned pilot whale
	Orcinus orca	Killer whale
	Feresa attenuata	Pygmy killer whale
	Kogia breviceps	Pygmy sperm whale
	Kogia simus	Dwarf sperm whale
	Delphinus delphis	Common dolphin
	Tursiops truncatus	Bottlenose dolphin
	Stenella frontalis	Atlantic spotted dolphin
	Lagenorhynchus acutus	Atlantic white-sided dolphin
	Lagenorhynchus albirostris	White-beaked dolphin
	Grampus griseus	Risso's dolphin
	Stenella coeruleoalba	Striped dolphin
	Phocoena phocoena	Harbor porpoise
Pinnipeds	*Halichoerus grypus*	Gray seal
	Phoca groenlandica	Harp seal
	P. vitulina	Harbor seal
	P. hispida	Ringed seal
	Cystophora cristata	Hooded seal
Sirenian	*Trichechus manatus latirostris*	Florida manatee

Source: USCG, 2002.

Table F.2-2
Nonendangered Marine and Coastal Birds of the Atlantic Region

Group	Family or Scientific Name	Common Name
Seabirds	Diomedeidae	Albatrosses
	Procellariidae	Petrels, shearwaters
	Sulidae	Gannets, boobies
	Phaethontidae	Tropic birds
	Pelecanidae	Pelicans
	Fregatidae	Frigate birds
	Phalacrocorcidae	Cormorants
	Scolopacidae	Phalaropes
	Laridae	Gulls, terns, noddies
	Rynchops	Skimmers
	Gaviidae	Loons
	Podicipedae	Grebes
Shorebirds	Haematopodidae	Oystercatchers
	Jacanidae	Jacanas
	Recuvirostridae	Stilts, avocets
	Scolopacdae	Sandpipers, snipes, turnstones
	Charadriidae	Plovers
Marsh and wading birds	Ardeidae	Herons, egrets
	Threskiornithidae	Ibises, spoonbills
	Gruidae	Cranes
	Rallidae	Rails, moorhens, gallinules, coots
	Ciconiidae	Storks
Waterfowl	Anatidae	Swans, ducks, geese
Raptors	*Falco peregrinus*	American peregrine falcon
	Circus cyaneus	Northern harrier

Source: USGS, 1998.

Table F.2-3
National Marine Sanctuaries and National Park Units in the Atlantic Region

The National Marine Sanctuaries Program administered by the National Oceanic and Atmospheric Administration (NOAA) was created in Title III of the Marine Protection, Research and Sanctuary Act of 1972 (33 USC 1401–1445, 16 USC 1431–1445). National Marine Sanctuaries are created to protect areas that have exhibited high levels of biodiversity, ecological integrity, and/or cultural legacy. They are the breeding and feeding grounds of whales, sea lions, sharks, and sea turtles and contain unique marine habitats. There are three coastal or near-coastal National Marine Sanctuaries in the Atlantic region.

National Marine Sanctuary	Description
Stellwagen Bank	This 842-mi^2 stretch of open water and seafloor at the mouth of Massachusetts Bay, offshore of MA is a sand and gravel plateau. This sanctuary is recognized as one of the primary feeding grounds of the highly migratory humpback whale in the North Atlantic; it is also the part-time home of the endangered northern right whale.
U.S.S. MONITOR	This sanctuary protects the wreck of the famed Civil War ironclad *U.S.S. MONITOR*, which rests upside down on a sand-covered seafloor, approximately 16 mi SSE of Cape Hatteras, NC, in 240 ft of water.
Gray's Reef	Gray's Reef comprises one of the largest nearshore sandstone reefs in the southeastern United States. This sanctuary is located 17.5 nm off Sapelo Island, GA, and its boundaries protect 17 mi^2 of open ocean.

continued

Table F.2-3 (*continued*)
National Marine Sanctuaries and National Park Units in the Atlantic Region

Congress established the National Park Service to ensure protection and interpretation of some of the finest examples of natural, cultural, and recreational resources. The National Park Service sets aside areas of historical and recreational value that are maintained at various stages of development, ranging from a natural pristine environment to recreational facilities and concessions. The development at any given park unit depends on the primary goal for which it was established. Park units set aside to preserve specific environments or historic locations may have localized areas developed to accommodate various uses, such as hunting, fishing, shell fishing, swimming, picnicking, hiking, camping, and boating. These uses must be compatible with the preservation of the environment or the historic location for which the park was established. There are eleven coastal or near-coastal National Park units in the Atlantic region.

National Park Unit	Description
Acadia NP	Located off the eastern coast of ME, this park encompasses 47,633 acres of granite-domed mountains, woodlands, lakes and ponds, and ocean shoreline.
Cape Cod NS	Extending between Chatham, MA and Provincetown, MA, Cape Cod NS covers 43,604 acres of shoreline and upland landscape features, including a 40-mi long stretch of pristine sandy beach and dozens of clear, deep, freshwater kettle ponds.
New Bedford Whaling NHP	This historical park encompasses 34 acres spread over 13 city blocks and includes a visitor center in New Bedford, MA
Fire Island NS	One hour east of New York City, NY, this 32-mi long seashore contains natural features such as the Otis Pike Fire Island Wilderness, the only federal wilderness in NY, and the Sunken Forest, a 300-year-old holly forest.
Assateague Island NS	This seashore's land and water boundaries encompass over 48,000 coastal acres in both MD and VA. Assateague Island is a 37-mi barrier island where bands of wild horses roam freely.
Colonial NHP	Situated along the James River on the VA Peninsula, this historical park covers five units (including Jamestown, the first permanent English settlement in North America, and Yorktown Battlefield, the final major battle of the American Revolutionary War) and spans over 9,000 acres.
Cape Hatteras NS	Stretched over 70 mi of NC barrier islands (Bodie, Hatteras, and Ocracoke), includes long stretches of beach, sand dunes, marshes, and woodlands that provide a variety of habitats and are a valuable wintering area for migrating waterfowl.
Cape Lookout NS	This seashore is a 56-mi long section of the Outer Banks, NC. Native grasslands comprise the only remaining natural grasslands in the eastern United States. The seashore also marks the northernmost edge of the range of the loggerhead turtle and provides one of the southernmost habitats for the threatened piping plover.
Cumberland Island NS	Located along the GA coast, it is a 17.5-mi long barrier island totaling 36,415 acres, of which 16,850 acres are marsh, mud flats, and tidal creeks. The seashore is well known for its sea turtles and abundant shorebirds.
Canaveral NS	A 59,300-acre barrier island with adjacent waterways on FL's east coast, and it contains over 100 archeological sites and the second largest number of federally listed threatened and endangered species in the entire National Park System.
Biscayne NP	With boundaries containing the longest stretch of mangrove forest left on FL's east coast, it is the largest marine park in the National Park System, with 95 percent of its 173,000 acres covered by water.

Source: For National Marine Sanctuaries, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://www.sanctuaries.nos.noaa.gov/oms/oms.html,* revised January 14, 2003). For National Park units, ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Figure F.2-1
National Marine Sanctuaries and National Park Units in the Atlantic Region

Source: For National Marine Sanctuaries, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://www.sanctuaries.nos.noaa.gov/oms/oms.html,* revised January 14, 2003). For National Park units, ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: NHP, National Historical Park; NP, National Park; NS, National Seashore. Map is not to scale.

Table F.2-4
National Wildlife Refuges in the Atlantic Region

The National Wildlife Refuge System is a network of U.S. lands and waters managed specifically for the enhancement of wildlife. National Wildlife Refuges were established and are administered by the U.S. Fish and Wildlife Service (USFWS) under the Fish and Wildlife Act of 1956 (16 USC 742a–742j, not including 742 d-l; 70 Stat. 1119) and the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd–668ee). These acts allow the USFWS to acquire and to administer lands for the development, advancement, management, conservation, and protection of fish and wildlife resources. Most refuges are managed for the enhancement of resident and migratory wildlife and are available for public recreational use, such as fishing, wildlife observation, hunting, and boating. There are seventy-nine coastal or near-coastal National Wildlife Refuges in the Atlantic region.

National Wildlife Refuge	Description
Moosehorn	The easternmost National Wildlife Refuge in the Atlantic Flyway. It covers 17,200 acres and is located southwest of Calais, ME, and 7,200-acres border the tidal waters of Cobscook Bay, ME.
Petit Manan Complex • Petit Manan • Cross Island • Franklin Island • Seal Island • Pond Island	Contains forty-two offshore islands and three coastal parcels, totaling more than 7,300 acres and spanning more than 150 mi of ME coastline. These islands provide habitat for common, Arctic, and endangered roseate terns; Atlantic puffins; razorbills; black guillemots; Leach's storm-petrels; laughing gulls; and common eiders.
Rachel Carson	This 4,700-acre refuge preserves ten estuaries along 45 mi of coast between Portsmouth, NH, and Portland, ME. These estuaries are key points along migration routs of waterfowl and other migratory birds.
Great Bay	Located in the Seacoast Travel Region of NH, this 5,300-acre refuge for migrating waterfowl is characterized by tidal waters, coastal lands, and wetlands.
Parker River	Consists of 4,662 acres of diverse upland and wetland habitats near Newbury Port, MA, including the southern three-fourths of Plum Island, an 8-mi barrier island. It is a vital stopover along the Atlantic Flyway for waterfowl, shorebirds, and songbirds.
Eastern Massachusetts Complex • Massasoit • Monomoy • Mashpee • Nantucket • Nomans Land Island	Situated along the Atlantic Flyway in MA, this complex is the only federally designated Wilderness Area in southern New England. The individual refuges include inland and coastal wetlands, forests, grasslands, and barrier beaches that provide important habitat for migratory birds.
Rhode Island Complex • Block Island • John H. Chafee • Ninigret • Sachuest Point • Trustom Pond	This complex is a 1,386-acre area of sand plain and beach strand communities that support (over 70 species) of migratory songbirds and waterfowl. It is located along the RI coast.
Stewart B. McKinney	This refuge is composed of eight units spanning 60 mi of CT coastal shoreline. Located in the Atlantic Flyway, the refuge provides important resting, feeding, and nesting habitat for many species of wading birds, shorebirds, songbirds, and terns, including the endangered roseate tern.
Long Island Refuges Complex • Conscience Point • Elizabeth A. Morton • Amagansett • Wertheim • Sayville • Seatuck • Oyster Bay • Target Rock	This complex preserves, manages, and restores some of the last significant natural areas for wildlife on Long Island, NY. Habitat ranges from coastal systems to native grasslands to mature forests. These habitats, spread over nine distinct units (including Lido Beach Wildlife Management Area), support threatened and endangered species in addition to hundreds of species of migratory wildlife within the Atlantic Flyway.

continued

Table F.2-4 (*continued*)
National Wildlife Refuges in the Atlantic Region

National Wildlife Refuge	Description
Wallkill River	As a major watershed and wetland complex, this 4,200-acre refuge, located in Sussex, NJ, provides migratory and nesting habitat for numerous Atlantic Flyway waterfowl.
Great Swamp	Located in Morris County, NJ, this refuge consists of 7,500 acres of varied habitats for more than 244 species of birds.
Edwin B. Forsythe	This refuge covers 46,000 acres and is located north of Atlantic City, NJ, and supports several federal- and state-listed bird species. It is a Wetland of International Importance under the Ramsar Convention.
Supawna Meadows	Located along the lower Delaware River in NJ, this 2,800-acre refuge includes brackish tidal marshes that provides feeding and resting habitat for migratory waterfowl. The refuge also provides feeding habitat for nearby Pea Patch Island, which hosts over 6,000 pairs of herons and egrets, the largest colonial wading bird rookery north of FL on the East Coast.
Cape May	The refuge is located on the Cape May peninsula in Middle, Dennis, and Upper Townships, NJ, encompassing more than 8,000 acres. The peninsula has the second largest concentration of shorebirds in the United States. It is also a Wetland of International Importance under the Ramsar Convention.
Bombay Hook	Located on the western shore of Delaware Bay, DE, this refuge encompasses 15,978 acres, of which approximately four-fifths is tidal salt marsh. The refuge has one of the largest expanses of nearly unaltered tidal salt marsh in the mid-Atlantic region, and it is primarily a refuge and breeding ground for migrating birds and other wildlife.
Prime Hook	This refuge located near the western shore of Delaware Bay near Dover, DE. consists of 8,817 acres, of which approximately 6,800 acres are fresh marsh, tidal marsh, and water.
Patuxent	Located between Washington, DC, and Baltimore, MD, this 12,750-acre refuge is the only National Wildlife Refuge established to support wildlife research. The refuge provides year-round habitat for migratory waterfowl.
Susquehanna	This refuge is a small island less than 1.5 acres in size, located at the mouth of the Susquehanna River in Harford County, MD. It was created when Presidential Proclamations closed 13,363 acres of water in the Upper Chesapeake Bay to the hunting of migratory waterfowl.
Eastern Neck	This 2,285-acre refuge is located at the mouth of the Chester River on the eastern side of Chesapeake Bay in Kent County, MD. It is a major feeding and resting place for migratory and wintering waterfowl.
Blackwater	Located on the Eastern Shore of MD, south of Cambridge, this refuge includes almost 26,000 acres, mainly of rich tidal marsh.
Glen Martin	This refuge encompasses the northern half of Smith Island (west of Chrisfield, MD) and Watts Island, in the lower Chesapeake Bay. It is in the heart of one of the largest waterfowl feeding areas on the Chesapeake Bay.
Potomac River Complex • Mason Neck • Occoquan Bay • Featherstone	The refuges in this complex are located along the Potomac River in Northern VA. The 2,277-acre Mason Neck provides nesting, feeding, and roosting habitat for bald eagles. Approximately 50% of Occoquan Bay's 644 acres is wetland habitats; over 220 species of birds.
Chincoteague	This refuge consists of over 14,000 acres, the majority of which are located on the VA portion of Assateague Island. The largest collection of near-pristine barrier islands in the country is found here. It is also one of the top five-shorebird migratory staging areas in the United States east of the Rocky Mountains.
Wallops Island	Located southwest of Chincoteague, VA, this refuge was created when 373 acres of land were transferred to the USFWS from the National Aeronautics and Space Administration (NASA). The refuge, comprised mainly of salt marsh and woodlands, contains habitat for a variety of species, including upland- and wetland-dependent migratory birds.

continued

Table F.2-4 (*continued*)
National Wildlife Refuges in the Atlantic Region

National Wildlife Refuge	Description
Fisherman Island	The Virginia barrier island chain, which includes this refuge, is classified as a Wetland of International Importance. The 1,850-acre refuge is the southernmost island in the chain, protecting critical habitats for coastal species such as royal terns and brown pelicans, and providing a resting and feeding stop along the migration route for thousands of other species.
Eastern Shore of Virginia	Located at the southern tip of the Delmarva Peninsula, this refuge was established for migratory and endangered species management and for wildlife-oriented recreation. The 752 acres of maritime forest, myrtle and bayberry thickets, grasslands, croplands, and fresh and brackish ponds provide important habitat for wildlife.
Plum Tree Island	This refuge is located entirely within the city boundary of Poquoson, VA, and a strip of high salt marsh separates the refuge from any developable land. The majority of the area is under tidal influence that occurs twice daily on an estimated 1,000 acres of low-lying salt marsh. During high tides and extreme storms, an additional 1,500 acres are normally flooded.
Eastern Virginia Rivers Complex • Rappahannock River Valley • Presquile • James River	At least six federally listed threatened or endangered species may be found within the 5,306 acres of the Rappahannock River. Presquile is a 1,329-acre island refuge that provides prime wetland habitat for wintering Canada geese, wood ducks, black ducks, and mallards. James River, a 4,200-acre refuge, was established to protect the bald eagle and provides one of the best roosting sites on the East Coast.
Nansemond	Located 10 mi west of Portsmouth in Suffolk, VA, the refuge habitat is composed mostly of tidal marshland. It provides habitat for migratory waterfowl, including black ducks, mallards, and canvasbacks, as well as wading, marsh, and shorebirds.
Back Bay	Located near Virginia Beach, VA, this 8,000-acre refuge is situated on and around a thin strip of coastline typical of barrier islands found along the Atlantic and Gulf coasts. The majority of refuge marshlands are on islands contained within the waters of Back Bay. Approximately 10,000 snow geese and a large variety of ducks visit the refuge during the peak of fall migration.
Great Dismal Swamp	Located in southeastern VA and northeastern NC, this refuge consists of over 111,000 acres of forested wetlands. Over 200 species of birds have been identified since the refuge's establishment; ninety-six of these species have been reported as nesting on or near the refuge.
Mackay Island	Located on the north side of Currituck Sound, this 8,138-acre refuge is in the northeastern corner of NC and southeastern corner of VA. It is an important wintering area for ducks, geese, and tundra swans.
Roanoke River	This refuge 17,500-acre refuge runs along 70 mi of the Roanoke River from Hamilton, NC, to the western Albemarle Sound. Concentrations of wintering waterfowl, nesting ducks, raptors, osprey, and neotropical migrants are common. The largest inland heron rookery in NC is located here.
Pocosin Lakes	Once the southern extremity of the Great Dismal Swamp, this 113,674-acre refuge in Hyde, Tyrrell, and Washington Counties, NC, supports ducks, geese, tundra swans, and raptors.
Currituck	This 4,1093-acre refuge is located north of Corolla, NC, on the Outer Banks barrier island strand and provides habitat for concentrations of wading birds, shorebirds, waterfowl, and raptors. Piping plover and loggerhead sea turtles occasionally nest on the refuge.
Pea Island	Located on the north end of Hatteras Island, NC, this refuge includes 5,834 acres of land and 25,700 acres of proclamation boundary waters. The refuge is midway on the Atlantic Flyway, providing a feeding and resting area for many species of wintering waterfowl, migrating shorebirds, raptors, wading birds, and neotropical migrants.
Alligator River	This refuge is on 152,000 acres in the mainland portion of Dare and Hyde Counties, NC, and is bound by Albemarle Sound on the north, Croatan and Pamlico Sounds on the east, and Long Shoal River on the south. It was established to preserve and protect a unique wetland habitat type—the pocosin (meaning "swamp-on-a-hill," characterized by poorly drained soils high in organic material)—and its associated wildlife species. The refuge is one of the last remaining strongholds for black bear on the eastern seaboard.

continued

Table F.2-4 (*continued*)
National Wildlife Refuges in the Atlantic Region

National Wildlife Refuge	Description
Mattamuskeet	This 50,180-acre refuge's main feature is Lake Mattamuskeet (40,000 acres), which is the largest natural lake in NC. Located in Swan Quarter, NC, the refuge has significant wintering populations of ducks, Canada geese, snow geese, and tundra swans.
Swanquarter	Located on the north shore of Pamlico Sound in Hyde County, NC, this 16,411-acre refuge has approximately 8,800 acres of National Wilderness Area. There are concentrations of diving ducks, sea ducks, American black ducks, wading birds, and shorebirds. The habitat consists of irregularly flooded brackish marsh and forested wetlands.
Cedar Island	This 14,480-acre refuge is located northeast of Beaufort, NC, along the confluence of the Pamlico and Core Sounds. Its main feature is an extensive, relatively undisturbed coastal marsh. There are concentrations of diving ducks, sea ducks, American black ducks, black rails, wading birds, and shorebirds.
Waccamaw	Located in Awendaw, SC, this refuge includes portions of the Great Pee Dee, Little Pee Dee, and Waccamaw Rivers. Consisting of 6,000 acres, it supports a large concentration of wintering waterfowl, wading birds, and neotropical migratory songbirds.
Santee	Located south of Sumter, SC, this 15,095-acre refuge provides habitat for four endangered or threatened species: Southern bald eagle, red-cockaded woodpecker, peregrine falcon, and American alligator. It is also a major wintering area for ducks, geese, and swans, and a nesting and stopover area for neotropical migratory birds, raptors, shore birds, and wading birds.
Cape Romain	Located in Charleston County, SC, this refuge is part of the Carolinian-South Atlantic Biosphere Reserve. Of the refuge's 64,229 acres, 28,000 acres are in the National Wilderness Preservation System. The refuge harbors the largest wintering populations of American oystercatchers and marbled godwits in the United States and is recognized as an International Site for shorebirds. It has the largest loggerhead sea turtle rookery in the United States outside FL and one of the largest Eastern brown pelican and least tern rookeries in the state.
ACE Basin	This refuge helps protect the largest undeveloped estuary along the Atlantic coast, with rich bottomland hardwoods and fresh- and saltwater marsh offering food and cover to a variety of wildlife. ACE Basin stands for the Ashepoo, Combahee, and Edisto Rivers, which form the estuary and parts of the refuge boundary. The entire basin encompasses more than 350,000 acres, of which the refuge comprises just less than 12,000 acres.
Savannah Coastal Refuges Complex • Pinckney Island (SC) • Tybee (SC) • Savannah (GA) • Wassaw (GA) • Harris Neck (GA) • Blackbeard Island (GA) • Wolf Island (GA)	This chain of NWRs extends from Hilton Head Island, SC, to Darien, GA. These refuges span a 100-mi coastline and total over 56,000 acres. Savannah is the largest unit in the complex, with over 28,000 acres of freshwater marshes, tidal rivers and creeks, and bottomland hardwoods.
Okefenokee	Located near Folkston, GA, this 396,000-acre refuge includes 353,981 interior acres designated as a National Wilderness Area. The swamp remains one of the oldest and most well-preserved freshwater areas in the United States, extending 38 mi north to south and 25 mi east to west. Prairies cover about 60,000 acres of the swamp. The prairies harbor a variety of wading birds: herons, egrets, ibises, cranes, and bitterns.
Lake Woodruff	This 21,552-acre refuge, located 25 mi west of Daytona Beach, FL, surrounds the 2,200-acre Lake Woodruff, 1,800-acre Lake Dexter, and numerous other waterways including the St. Johns River, which forms the refuge's western boundary. There are concentrations of ducks, wading birds, raptors, and deer; several endangered and threatened species are protected including manatee, snail kite, wood stork, bald eagle, limpkin, indigo snake, gopher tortoise, and American alligator.

continued

Table F.2-4 (*continued*)
National Wildlife Refuges in the Atlantic Region

National Wildlife Refuge	Description
Merritt Island	Administered by NASA as part of the John F. Kennedy Space Center east of Titusville, FL, this 140,000-acre refuge is approximately one-half brackish estuaries and marshes. Over 500 species of wildlife inhabit the refuge, with 16 being listed as threatened or endangered.
St. Johns	This 6,194-acre refuge, located west of Titusville, FL, was established to provide adequate habitat to recover the dusky seaside sparrow from extinction. However, the species was declared extinct in December 1990, and the refuge's critical habitat was delisted.
Archie Carr	This linear refuge stretches for 20 mi between Melbourne Beach and Wabasso Beach along FL's east coast. It is the most important nesting area for loggerhead sea turtles in the western hemisphere and the second most important nesting beach in the world. Twenty-five percent of all loggerhead sea turtle and 35% of all green sea turtle nests in the United States occur here, with nesting densities of 1,000 nests per mi.
Pelican Island	This 5,413-acre refuge is the first official NWR, which was established by President Theodore Roosevelt in March 1903. Located in Indian River County, FL, the refuge was designated to protect brown pelicans and other native birds nesting on the island. It was the first time the federal government set aside land for the sake of wildlife.
Hobe Sound	This coastal refuge consists of two separate tracts of land located in Martin County, FL. These tracts total only 967 acres in three basic, distinct plant communities: coastal sand dune, mangrove swamps, and sand pine-scrub oak forest. The 735-acre Jupiter Island beach tract provides some of the most productive sea turtle nesting beach in the United States.
Arthur R. Marshall Loxahatchee	This 147,392-acre refuge, the last northernmost portion of the unique Everglades, has over 221 mi^2 of Everglades habitat and is home to the American alligator and the endangered Everglades snail kite. In any given year, as many as 257 species of birds may use the refuge's diverse wetland habitats.
Crocodile Lake	Located in north Key Largo, FL, this 6,606-acre refuge includes the last stands of high tropical hardwood hammock and provides critical habitat to Key Largo woodrat, cotton mouse, and the only federally listed endangered insect in Florida: Schaus' swallowtail butterfly.

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Figure F.2-2
National Wildlife Refuges in the Atlantic Region—North

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Note: Map is not to scale.

Figure F.2-3
National Wildlife Refuges in the Atlantic Region—South

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Note: Map is not to scale.

Table F.2-5
National Estuarine Research Reserves and National Estuary Programs in the Atlantic Region

The National Estuarine Research Reserve Program was established by the Coastal Zone Management Act of 1972 (16 U.S.C. 1451–1464) and is administered by the Sanctuaries and Reserves Division, NOAA. A primary objective of Congress in establishing the estuarine research-reserve program is to provide information to be used by coastal managers and fishing industries by providing research information that will help assure the continued productivity of estuarine ecosystems. The Coastal Zone Management Act of 1972, as amended, established the National Estuarine Sanctuary Program to provide financial assistance awards on a matching basis to states to acquire, develop, and operate estuarine areas as natural field laboratories. The purpose of the program is to provide long-term protection to vital habitats for estuarine-dependent life, thus preserving relatively unaltered estuarine areas for baseline scientific research and educational programs. There are thirteen coastal or near-coastal National Estuarine Research Reserves in the Atlantic region, of which two are also National Estuary Programs.

National Estuarine Research Reserve	Description
Wells	This 1,600-acre reserve protects fields, forests, salt marshes, and sandy beaches on the densely populated southern coast of ME. Gulf of Maine waters join with the Webhannet and Little Rivers to form broad estuaries, in which the salt marshes account for 1,200 acres of the reserve.
Great Bay	Encompassing over 10,000 acres of tidal waters, this reserve is a complex embayment in the southeastern corner of NH that begins at the mouth of the Piscataqua River. The reserve is a tidally dominated system and the drainage confluence of seven major rivers, several small creeks and their tributaries, and ocean water from the Gulf of Maine. It is one of the largest estuaries on the Atlantic Coast and at 10 mi inland is one of the most recessed.
Waquoit Bay	Located on the south shore of Cape Cod, MA, in the towns of Falmouth and Mashpee, this reserve encompasses 2,500 acres of open waters, barrier beaches, marshlands, and uplands. Its beaches serve as nesting grounds for the threatened piping plover and foraging grounds for the endangered roseate tern.
Narragansett Bay	Narragansett Bay is both a National Estuarine Research Reserve and a National Estuary Program, and is located in the geographic center of Narragansett Bay, between Newport and Providence, RI. It encompasses 2,353 acres of land on Prudence, Patience, and Hope Islands and 1,591 acres of water adjoining the islands out to a depth of 18 ft.
Hudson River	This 4,838-acre reserve is a network of four coastal wetlands—Piermont Marsh, Iona Island, Tivoli Bays, and Stockport Flats—located along 100 mi of the Hudson Estuary in NY state. It is home to more than 200 species of fish, serving as a nursery ground for fish such as sturgeon, striped bass, and American shad.
Jacques Costeau	Located at Mullica River and Great Bay in NJ, this 114,665-acre reserve is the only National Estuarine Research Reserve in the system to be named after an individual and to expand its boundaries seaward to the Atlantic Ocean. It is regarded as one of the least disturbed estuaries in the densely populated urban corridor of the northeastern United States and, in addition to the ocean environment, encompasses wetlands, riparian habitats, barrier islands, and forested uplands of the NJ Pine Barrens.
Delaware Estuary	Delaware Estuary is both a National Estuarine Research Reserve and a National Estuary Program and extends 134 mi from its mouth between Cape May, NJ, and Cape Henlopen, DE, northward to Trenton Falls, NJ. With a water surface area of 768 mi^2, this estuary is one of the largest along the Atlantic coast, covering 8,600 acres.
Chesapeake Bay-MD	Chesapeake Bay, the largest estuary in the nation, is one of the most productive bodies of water in the world and is highly valued for its commercial and recreational resources. The 4,820-acre reserve in MD has three components: Jug Bay, which is a tidal freshwater riverine habitat in a developed watershed; Monie Bay, which represents a salt marsh habitat; and Otter Point Creek, which is an upper bay tidal freshwater habitat.
Chesapeake Bay-VA	Chesapeake Bay, the largest estuary in the nation, is one of the most productive bodies of water in the world and is highly valued for its commercial and recreational resources. The 4,435-acre reserve in VA consists of four components within the York River basin: Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh.

continued

Table F.2-5 (*continued*)
National Estuarine Research Reserves and National Estuary Programs in the Atlantic Region

National Estuarine Research Reserve	Description
North Carolina	This reserve, the third largest in the United States, encompasses more than 2 million acres and provides the economic foundation of the coastal area. It is comprised of four sites located near Corolla (Currituck Banks), Beaufort (Rachel Carson), and Wilmington (Mansonboro Island and Zeke's Island), NC.
North Inlet-Winyah Bay	Located 50 mi north of Charleston, SC, this 12,327-acre reserve features the salt marshes and ocean dominated tidal creeks of the North Inlet Estuary plus the brackish waters and marshes of the adjacent Winyah Bay Estuary, which is the third largest watershed on the East Coast. More than 90 percent of North Inlet's watershed is in its natural forested state.
ACE Basin	This 134,710-acre reserve is located 45 mi south of Charleston, SC, and is one of the most undeveloped estuaries on the East Coast. It features outer coastal plain communities that are typically associated with barrier islands, marsh islands, and estuarine rivers.
Sapelo Island	Sapelo Island is the fourth largest barrier island in GA and one of the most pristine. The 17,950-acre reserve, located northeast of Darien, GA, is made up of salt marshes, maritime forests, and beach dune areas.

In 1987, the National Estuary Program (NEP) was established by the Water Quality Act (P.L. 100-4) and is administered by U.S. Environmental Protection Agency (USEPA). The purposes of the program are to identify nationally significant estuaries, protect and improve their water quality, and enhance their living resources. Under the administration of USEPA, comprehensive management plans are generated to protect and enhance environmental resources of estuaries designated to be of national importance. The governor of a state may nominate an estuary for the program and request that a Comprehensive Conservation and Management Plan be developed. Over a 5-year period, representatives from federal, state, and interstate agencies; academic and scientific institutions, and industry and citizen groups do the following: (1) define objectives for protecting the estuary, (2) select the chief problems to be addressed in the plan, and (3) ratify a pollution control and resource management strategy to meet each objective. Strong public support and subsequent political commitments are needed to accomplish the actions called for in the plan. There are fourteen coastal or near-coastal National Estuary Programs in the Atlantic region, of which two are also National Estuarine Research Reserves.

National Estuary Program	Description
Casco Bay	Located in southeastern ME, the marine habitats of Casco Bay cover 229 mi^2. Because of topography and wide tidal variations that are characteristic of the Gulf of Maine, intertidal areas in ME are the most extensive along the Atlantic coast of the United States. The most characteristic intertidal habitat in Casco Bay is tidal flats covering 11,582 acres.
New Hampshire Estuaries	NH has over 230 mi of sensitive tidal shoreline in addition to 18 mi of open ocean coastline on the Gulf of Maine. The largest estuaries in the system are Great Bay Estuary and Hampton-Seabrook Estuary. Great Bay Estuary is a tidally dominated, complex embayment on the southern NH-ME border, with estuarine tidal waters covering 17 mi^2, with nearly 150 mi of tidal shoreline. Hampton-Seabrook Estuary encompasses 0.75 mi^2 of water at high tide and contains the largest salt marsh in the state.
Massachusetts Bays	Covering over 800 mi of coastline from the tip of Cape Cod Bay, MA, to the NH border and serving 50 coastal communities, the Massachusetts Bays provide habitats for horseshoe crabs, blue herons, striped bass, and eelgrass.
Buzzards Bay	Located in southeastern MA, the Buzzards Bay watershed encompasses almost 750 mi^2 and provides diverse habitat of salt marshes, sandy beaches, eelgrass beds, small embayments, tidal streams, and urban ports.
Narragansett Bay	Narragansett Bay is both a National Estuarine Research Reserve and a National Estuary Program, and is located in the geographic center of Narragansett Bay, between Newport and Providence, RI. It encompasses 2,353 acres of land on Prudence, Patience, and Hope Islands and 1,591 acres of water adjoining the islands out to a depth of 18 ft.
Long Island Sound	Bounded by CT and Westchester County, NY, on the north and by Long Island, NY, on the south, Long Island Sound is approximately 110 mi long and about 21 mi across at its widest point. Unlike most other estuaries, Long Island Sound has two connections with the ocean: through the East River-New York Harbor to the west and through the Race to the east.

continued

Table F.2-5 (*continued*)
National Estuarine Research Reserves and National Estuary Programs in the Atlantic Region

National Estuary Program	Description
Peconic Bay	Located between the North and South Forks of Long Island, NY, the Peconic estuarine system consists of over 100 harbors, embayments, and tributaries that span more than 110,000 acres of land and 121,000 acres of surface water. Most of the estuary's primary habitats—sandy beaches, cliffs, dunes, salt marshes, and freshwater wetlands—remain in a fairly natural condition.
New York-New Jersey Harbor	The New York-New Jersey Harbor Estuary includes the waters of the harbor and the tidally influenced portions of all rivers and streams that empty into the harbor. Its core area, the Hudson Raritan Estuary, extends from the Piermont Marsh, NY, to the Sandy Hook-Rockaway Point Transect, NJ. The estuary covers approximately 298 mi^2 of surface water.
Barnegat Bay	The Barnegat Bay Estuary covers over 42 mi of shoreline from the Point Pleasant Canal to Little Egg Harbor Inlet in NJ. The flow of fresh water from rivers, creeks, and groundwater into the bay produces the special conditions that are important for the survival of crabs, fish, birds, and other wildlife.
Delaware Estuary	Delaware Estuary is both a National Estuarine Research Reserve and a National Estuary Program and extends 134 mi from its mouth between Cape May, NJ, and Cape Henlopen, DE, northward to Trenton Falls, NJ. With a water surface area of 768 mi^2, this estuary is one of the largest along the Atlantic coast, covering 8,600 acres.
Delaware Inland Bays	These are three bays—Rehoboth, Indian River, and Little Assawoman Bays—located along the southern coast of DE. The surface water of the bays covers 32 mi^2. The bays' physical connections with the Atlantic Ocean are limited. Unlike most estuaries that receive the bulk of their freshwater inflow from rivers, the Delaware Inland Bays receive as much as 80 percent of their fresh water from groundwater sources.
Maryland Coastal Bays	The Maryland Coastal Bays are located off the Eastern Shore of MD. The estuarine study area includes four large, shallow bays as well as some smaller embayments. The bays' watershed totals 119,187 acres in Worcester County, MD, and extends into portions of DE and VA. While the northern portion of the bays is quickly developing, the southern portion maintains a significant amount of forested and agricultural land.
Albemarle-Pamlico Sounds	The Albemarle-Pamlico Sounds region stretches from Prince George County, VA, to Carteret County, NC, and covers 30,000 mi^2 of watershed, making it the second largest estuarine system in the United States after the Chesapeake Bay. It is composed of seven sounds and five major river basins, as well as beaches, marshes, and bottomland forests.
Indian River	Stretching for a total of 155 mi from Ponce de Leon Inlet in New Smyrna Beach, FL, south to Jupiter Inlet in Palm Beach, FL, the lagoon forms 40 percent of the FL east coast and has a water surface area of 353 mi^2.

Source: For National Estuarine Research Reserves, Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://nerrs.noaa.gov/Reserves.html*, revised September 25, 2003). For National Estuary Programs, Office of Water, U.S. Environmental Protection Agency (*http://www.epa.gov/owow/estuaries/find.htm*, updated February 25, 2003).

Figure F.2-4
National Estuarine Research Reserves and National Estuary Programs in the Atlantic Region

Source: For National Estuarine Research Reserves, Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://nerrs.noaa.gov/Reserves.html,* revised September 25, 2003). For National Estuary Programs, Office of Water, U.S. Environmental Protection Agency (*http://www.epa.gov/owow/estuaries/find.htm*, updated February 25, 2003).

Note: Map is not to scale.

Table F.2-6
Coastal County* Population of the Atlantic Region

State	County	Population	State	County	Population
ME	Androscoggin	265,612	CT	Tolland	136,364
	Cumberland	29,467		Windham	109,091
	Franklin	51,791	NY	Albany	294,565
	Hancock	117,114		Bronx	1,332,650
	Kennebec	39,618		Columbia	63,094
	Knox	33,616		Dutchess	280,150
	Lincoln	54,755		Greene	48,195
	Oxford	144,919		Kings	2,465,326
	Penobscot	35,214		Nassau	1,334,544
	Sagadahoc	50,888		New York	1,537,195
	Somerset	36,280		Orange	341,367
	Waldo	33,941		Putnam	95,745
	Washington	183,750		Queens	2,229,379
	York	103,793		Rensselaer	152,538
NH	Belknap	56,325		Richmond	443,728
	Carroll	43,666		Rockland	286,753
	Hillsborough	308,841		Schenectady	146,555
	Merrimack	136,225		Suffolk	1,419,369
	Rockingham	277,359		Ulster	177,749
	Strafford	112,233		Westchester	923,459
MA	Barnstable	222,230	NJ	Atlantic	252,552
	Berkshire	134,953		Bergen	884,118
	Bristol	534,678		Burlington	423,394
	Dukes	14,987		Camden	508,932
	Essex	723,419		Cape May	102,326
	Hampden	456,228		Cumberland	146,438
	Middlesex	1,465,396		Essex	793,633
	Nantucket	9,520		Gloucester	254,673
	Norfolk	650,308		Hudson	608,975
	Plymouth	472,822		Hunterdon	121,989
	Suffolk	689,807		Mercer	350,761
	Worcester	750,963		Middlesex	750,162
RI	Bristol	50,648		Monmouth	615,301
	Kent	167,090		Morris	470,212
	Newport	85,433		Ocean	510,916
	Providence	621,602		Passaic	489,049
	Washington	123,546		Salem	64,285
CT	Fairfield	882,567		Somerset	297,490
	Hartford	857,183		Sussex	144,166
	Litchfield	182,193		Union	522,541
	Middlesex	155,071	PA	Adams	91,292
	New Haven	824,008		Berks	373,638
	New London	259,088		Bucks	597,635

continued

Table F.2-6 (*continued*)
Coastal County* Population of the Atlantic Region

State	County	Population	State	County	Population
PA	Chester	433,501	VA	Cumberland	9,017
	Delaware	550,864		Dinwiddie	24,533
	Lancaster	470,658		Essex	9,989
	Lebanon	120,327		Fairfax	969,749
	Lehigh	312,090		Fairfax City	21,498
	Montgomery	750,097		Falls Church	10,377
	Philadelphia	1,517,550		Fauquier	55,139
	Schuylkill	150,336		Fluvanna	20,047
	York	381,751		Fredericksburg	19,279
DE	Kent	126,697		Gloucester	34,780
	New Castle	500,265		Goochland	16,863
	Sussex	156,638		Hampton	146,437
MD	Anne Arundel	489,656		Hanover	86,320
	Baltimore	754,292		Henrico	262,300
	Baltimore City	651,154		Hopewell	22,354
	Calvert	74,563		Isle of Wright	29,728
	Caroline	29,772		James City	48,102
	Carroll	150,897		King & Queen	6,630
	Cecil	85,951		King George	16,803
	Charles	120,546		King William	13,146
	Dorchester	30,674		Lancaster	11,567
	Harford	218,590		Louisa	25,627
	Howard	247,842		Manassas Park	10,290
	Kent	19,197		Manassas	35,135
	Montgomery	873,341		Mathews	9,207
	Prince George's	801,515		Middlesex	9,932
	Queen Anne's	40,563		New Kent	13,462
	St. Mary's	86,211		Newport News	180,150
	Somerset	24,747		Norfolk	234,403
	Talbot	33,812		Northampton	13,093
	Wicomico	84,644		Northumberland	12,259
	Worcester	46,543		Nottoway	15,725
Washington, DC		572,059		Orange	25,881
VA	Accomack	38,305		Petersburg	33,740
	Alexandria	128,283		Poquoson	11,566
	Ameila	11,400		Portsmouth	100,565
	Appomattox	13,705		Powhatan	22,377
	Arlington	189,453		Prince Edward	19,720
	Buckingham	15,625		Prince George	33,047
	Caroline	22,121		Prince William	280,813
	Charles City	6,926		Richmond	8,809
	Chesapeake	199,184		Richmond City	197,790
	Chesterfield	259,903		Spotsylvania	90,395
	Colonial Heights	16,897		Stafford	92,446

continued

Table F.2-6 (*continued*)
Coastal County* Population of the Atlantic Region

State	County	Population	State	County	Population
VA	Suffolk	63,677	SC	Berkeley	142,651
	Surry	6,929		Charleston	309,969
	Virginia Beach	425,257		Chesterfield	42,768
	Westmoreland	16,718		Clarendon	32,502
	Williamsburg	11,998		Colleton	38,264
	York	6,829		Darlington	67,394
NC	Anson	25,275		Dillon	30,722
	Beaufort	44,958		Dorchester	96,413
	Bertie	19,773		Florence	125,761
	Bladen	32,278		Georgetown	55,797
	Brunswick	73,143		Hampton	21,386
	Camden	6,885		Horry	196,629
	Carteret	59,383		Jasper	20,768
	Chowan	14,526		Kershaw	52,647
	Columbus	54,749		Lancaster	61,351
	Craven	91,436		Lee	20,119
	Cumberland	54,749		Marion	35,466
	Currituck	18,190		Marlboro	28,818
	Dare	29,967		Sumter	104,646
	Duplin	49,063		Williamsburg	37,217
	Edgecombe	55,606	GA	Appling	17,417
	Gates	10,516		Atkinson	7,609
	Halifax	57,370		Bacon	10,103
	Hertford	22,601		Brantley	14,629
	Hyde	5,826		Bryan	23,417
	Jones	10,381		Bulloch	55,985
	Lenoir	59,648		Camden	43,644
	Martin	25,593		Charlton	10,282
	New Hanover	160,307		Coffee	37,413
	Northampton	22,086		Effingham	37,535
	Onslow	150,355		Glynn	67,568
	Pamlico	12,934		Irwin	9,931
	Pasquotank	34,897		Jeff Davis	12,684
	Pender	41,082		Jenkins	8,575
	Perquimans	11,368		Liberty	61,610
	Pitt	133,798		Long	10,304
	Richmond	46,564		McIntosh	10,847
	Sampson	60,161		Montgomery	8,270
	Scotland	35,998		Pierce	15,636
	Tyrrell	4,149		Screven	15,374
	Washington	13,723		Tattnall	22,305
	Wayne	113,329		Toombs	26,067
	Wilson	73,814		Ware	35,483
SC	Allendale	11,211		Wayne	26,565
	Beaufort	120,937			

continued

Table F.2-6 (*continued*)
Coastal County* Population of the Atlantic Region

State	County	Population	State	County	Population
FL (east coast)	Baker	22,259	FL (east coast, con't)	Nassau	57,663
	Brevard	476,230		Okeechobee	35,910
	Broward	1,623,018		Orange	896,344
	Clay	140,814		Osceola	172,493
	Duval	778,879		Palm Beach	1,131,184
	Flagler	49,832		Putnam	70,423
	Hendry	36,210		St. Johns	123,135
	Indian River	112,947		St. Lucie	192,695
	Lake	210,528		Seminole	365,196
	Martin	126,731		Volusia	443,343
	Miami-Dade	2,253,362			

Source: U.S. Census Bureau, 2000.

* The Office of Ocean Resources, Conservation and Assessment (ORCA), National Ocean Service (NOS), National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce classifies counties as coastal "because they meet one of the following criteria: (1) at least 15 percent of their total land area is located within the nation's coastal watersheds (as defined by ORCA's Coastal Assessment Framework [*http://spo.nos.noaa.gov/projects/caf/caf.html*, page not dated], or (2) the county accounts for at least 15 percent of the land area of a coastal cataloging unit (a U.S. Geological Survey-defined drainage basin)" (*http://spo.nos.noaa.gov/projects/population/population.html*, page not dated). The U.S. Bureau of the Census also uses ORCA's coastal counties list.

F.3. CARIBBEAN REGION

Table F.3-1
Nonendangered Marine Mammals of the Caribbean Region

Group	Scientific Name	Common Name
Cetaceans	*Mesoplodon* and *Ziphidae* spp.	Beaked whale
	Globicephala spp.	Pilot whale
	Balaenoptera acutorostrata	Minke whale
	Stenella longirostris	Spinner dolphin
	Stenella coeruleoalba	Striped dolphin
	Steno bredanensis	Rough-toothed dolphin
	Stenella frontalis	Atlantic spotted dolphin
	Stenella attenuata	Pantropical spotted dolphin
	Tursiops truncatus	Bottlenose dolphin
Sirenian	*Trichechus manatus manatus*	Antillean manatee

Source: USCG, 2002.

Table F.3-2
Nonendangered Marine and Coastal Birds of the Caribbean Region

Group	Family Name	Common Name
Seabirds	Scolopacidae	Curlews, yellowlegs, whimbrels
	Charadriidae	Plovers, stilts, oystercatchers, lapwings
	Sulidae	Boobies
	Phaethontidae	Tropicbirds, gulls, terns, noddies
	Fregatidae	Frigate birds
	Procellariidae	Shearwaters, storm petrels, petrels
Shorebirds	Cerylidae	Kingfishers
	Trochilidae	Hummingbirds, mangos, emeralds
	Nyctibiidae	Northern potoos
	Columbidae	Pigeons, doves
	Aramidae	Limpkins
	Railidae	Rails, coots, moorhens, crakes
	Laridae	Gulls, skimmers, skuas, jaegers
	Phalacrocoracidae	Cormorants
	Ciconiidae	Vultures
	Fringillidae	Sparrows, warblers, canaries, juncos, parulas
Marsh and wading birds	Dendrocygnidae	Whistling ducks
	Vireonidae	Vireos
	Ardeidae	Bitterns, herons, egrets
	Pelecanidae	Pelicans
	Hirundinidae	Swallows, martins
Waterfowl	Anatidae	Wigeons, ducks, mallards, swans
Raptors	Accipitridae	Eagles, harriers, hawks
	Falconidae	Falcons, kestrels

Source: Raffaele et al., 1998.

Table F.3-3
National Park Units in the Caribbean Region

Congress established the National Park Service to ensure protection and interpretation of some of the finest examples of natural, cultural, and recreational resources. The National Park Service sets aside areas of historical and recreational value that are maintained at various stages of development, ranging from a natural pristine environment to recreational facilities and concessions. The development at any given park unit depends on the primary goal for which it was established. Park units set aside to preserve specific environments or historic locations may have localized areas developed to accommodate various uses, such as hunting, fishing, shell fishing, swimming, picnicking, hiking, camping, and boating. These uses must be compatible with the preservation of the environment or the historic location for which the park was established. There are four coastal or near-coastal National Park units in the Caribbean region.

National Park Unit	Description
San Juan NHS	This historic site encompasses the system of massive fortifications that defended the city of Old San Juan, PR, including the forts of El Morro, San Cristóbal, and El Cañuelo and the 5 mi of stone walls ringing the city. The site is a United Nations-designated World Heritage Site.
Virgin Islands NP*	This park covers more than 12,908 acres, including three-fifths of St. John, 15 acres of St. Thomas, and Hassel Island (in Charlotte Amalie Harbor, St. Thomas), and provides habitat for over 800 species of plants. The park also consists of 5,650 acres of offshore areas (waters and submerged lands), such as coral reefs, mangrove shorelines, and seagrass beds. The park is part of the United Nation's Biosphere Reserve Network.
Buck Island Reef NM	Located 1.5 mi off the northeast side of Buck Island near St. Croix, this National Monument encompasses 880 acres—176 acres of land and 704 acres of water and reef system. An elkhorn-coral barrier reef surrounds two-thirds of the island, which is a rookery for endangered brown pelicans and a nesting area for three species of sea turtles. Seasonally the reef supports one of the last remaining protected nesting populations of endangered hawksbill sea turtles in the eastern Caribbean.
Salt River Bay NHP and EPres	Located near Christiansted, St. Croix, USVI this is the only known site where members of Christopher Columbus' expedition set foot on what is now U.S. territory. The park contains the only ceremonial prehistoric ball court ever discovered in the Lesser Antilles, village middens, and burial grounds. The site is marked by Fort Sale, a remaining earthworks fortification from the Dutch period of occupation.

Source: ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: EPres, Ecological Preserve; NHP, National Historical Park; NHS, National Historic Site; NM, National Monument; NP, National Park. Map is not to scale.

* The Virgin Islands NP also includes Hassel Island and 15 acres on St. Thomas.

Figure F.3-1
National Park Units in the Caribbean Region—Puerto Rico

Source: For National Park units, ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: NHS, National Historic Site. Map is not to scale.

Figure F.3-2
National Park Units in the Caribbean Region—U.S. Virgin Islands

Source: ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: EPres, Ecological Preserve; NHP, National Historical Park; NM, National Monument; NP, National Park. Map is not to scale.

* The Virgin Islands NP also includes Hassel Island and 15 acres on St. Thomas.

Table F.3-4
National Wildlife Refuges in the Caribbean Region

The National Wildlife Refuge System is a network of U.S. lands and waters managed specifically for the enhancement of wildlife. National Wildlife Refuges were established and are administered by the USFWS under the Fish and Wildlife Act of 1956 (16 U.S.C. 742a–742j, not including 742 d-l; 70 Stat. 1119) and the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd–668ee). These acts allow the USFWS to acquire and to administer lands for the development, advancement, management, conservation, and protection of fish and wildlife resources. Most refuges are managed for the enhancement of resident and migratory wildlife and are available for public recreational use, such as fishing, wildlife observation, hunting, and boating. The National Wildlife Refuges of the Caribbean region provide habitat to a variety of migratory waterfowl and aquatic birds, including indigenous species, and several endangered species including green, leatherback, and hawksbill sea turtles; yellow-shouldered blackbird; brown pelican; and St. Croix ground lizard. There are eight coastal or near-coastal National Wildlife Refuges in the Caribbean region.

National Wildlife Refuge	Description
Caribbean Islands Complex • Desecheo (PR) • Cabo Rojo (PR) • Laguana Cartegena (PR) • Vieques (PR) • Culebra (PR) • Buck Island (USVI) • Green Cay (USVI) • Sandy Point (USVI)	Located off the west coast of PR, Desecheo is a 360-acre island. Cabo Rojo is a 587-acre refuge along the coastal plain of southwestern PR. Located near Maguayo, PR, the 1,059-acre Laguana Cartegena contains a partially filled lagoon. Vieques is a 3,100-acre refuge located on the western end of Isla de Vieques. The Culebra National Wildlife Refuge is comprised of lands on the main Isla de Culebra plus twenty-two smaller islands in the same vicinity. The 45-acre Buck Island, located 2 mi off the south coast of St. Thomas, USVI, is a nesting area for hawksbill and green sea turtles. Located directly off the north coast of St. Croix, USVI, Green Cay is a 14-acre refuge that provides critical habitat for one of only two remaining natural populations of the endangered St. Croix lizard. Sandy Point, located at the southwest end of St. Croix, USVI, consists of 327 acres and has the largest beach area in the USVI.

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated).

Figure F.3-3
National Wildlife Refuges in the Caribbean Region—Puerto Rico

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated).

Note: Map is not to scale.

Figure F.3-4
National Wildlife Refuges in the Caribbean Region—U.S. Virgin Islands

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated).
Note: Map is not to scale.

Table F.3-5
National Estuarine Research Reserves and National Estuary Programs in the Caribbean Region

The National Estuarine Research Reserve Program was established by the Coastal Zone Management Act of 1972 (16 U.S.C. 1451–1464) and is administered by the Sanctuaries and Reserves Division, NOAA. A primary objective of Congress in establishing the estuarine research-reserve program is to provide information to be used by coastal managers and fishing industries by providing research information that will help assure the continued productivity of estuarine ecosystems. The Coastal Zone Management Act of 1972, as amended, established the National Estuarine Sanctuary Program to provide financial assistance awards on a matching basis to states to acquire, develop, and operate estuarine areas as natural field laboratories. The purpose of the program is to provide long-term protection to vital habitats for estuarine-dependent life, thus preserving relatively unaltered estuarine areas for baseline scientific research and educational programs. There is one coastal or near-coastal National Estuarine Research Reserve in the Caribbean region.

National Estuarine Research Reserve	Description
Jobos Bay	Located on the southern coast of PR between the municipalities of Guayama and Salinas, this reserve encompasses 2,883 acres of land and water including a chain of fifteen mangrove islets (surrounded by coral reefs and seagrass beds). Four species of Caribbean mangroves are found in the reserve, which is also home to the endangered brown pelican, peregrine falcon, yellow-shoulder blackbird, hawksbill turtle, and the Antillean manatee.

In 1987, the NEP was established by the Water Quality Act (P.L. 100-4) and is administered by USEPA. The purposes of the program are to identify nationally significant estuaries, protect and improve their water quality, and enhance their living resources. Under the administration of USEPA, comprehensive management plans are generated to protect and enhance environmental resources of estuaries designated to be of national importance. The governor of a state may nominate an estuary for the program and request that a Comprehensive Conservation and Management Plan be developed. Over a 5-year period, representatives from federal, state, and interstate agencies; academic and scientific institutions, and industry and citizen groups do the following: (1) define objectives for protecting the estuary, (2) select the chief problems to be addressed in the plan, and (3) ratify a pollution control and resource management strategy to meet each objective. Strong public support and subsequent political commitments are needed to accomplish the actions called for in the plan. There is one coastal or near-coastal National Estuary Programs plus one Marine Conservation District in the Caribbean region.

National Estuary Program	Description
San Juan Bay	The first tropical island estuary in the National Estuary Program, San Juan Bay includes a 93-mi^2 watershed and consists of coral communities, sea grass beds, and mangrove forests, all of which are designated critical areas. It is home to several threatened or endangered bird species as well as the protected leatherback sea turtle.
Hind Bank Marine Conservation District	This 16-mi^2 conservation area is located in the Caribbean waters southwest of St. Thomas, USVI. This area is noted as a spawning ground for the red hind, a popular commercial fish, and valuable coral reefs. Within the district, fishing, anchoring of fishing vessels, traps, bottom long lines, and the harvesting of "live rock" are prohibited.

Source: For National Estuarine Research Reserve, Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://nerrs.noaa.gov/Reserves.html,* revised September 25, 2003). For National Estuary Program, Office of Water, U.S. Environmental Protection Agency (*http://www.epa.gov/owow/estuaries/find.htm*, updated February 25, 2003). For Marine Conservation District, National Marine Protected Areas Center, National Oceanic and Atmospheric Administration, U.S. Department of Commerce and U.S. Department of the Interior.

Figure F.3-5
National Estuarine Research Reserves and National Estuary Programs in the Caribbean Region—Puerto Rico

Source: For National Estuarine Research Reserves, Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://nerrs.noaa.gov/Reserves.html*, revised September 25, 2003). For National Estuary Programs, Office of Water, U.S. Environmental Protection Agency (*http://www.epa.gov/owow/estuaries/find.htm*, updated February 25, 2003).

Note: Map is not to scale.

Figure F.3-6
National Estuary Programs in the Caribbean Region—U.S. Virgin Islands

Source: National Marine Protected Areas Center, National Oceanic and Atmospheric Administration, U.S. Department of Commerce and U.S. Department of the Interior.

Note: Map is not to scale.

Table F.3-6
Coastal Island Population of the Caribbean Region

Island	Population
Puerto Rico	3,808,610
St Croix, USVI	53,234
St John, USVI	4,197
St. Thomas, USVI	51,181

Source: U.S. Census Bureau, 2000.

F.4. GULF OF MEXICO REGION

Table F.4-1
Nonendangered Marine Mammals of the Gulf of Mexico Region

Group	Scientific Name	Common Name
Cetaceans	*Balaenoptera edeni*	Bryde's whale
	Balaenoptera acutorostrata	Minke whale
	Kogia breviceps	Pygmy sperm whale
	Kogia simus	Dwarf sperm whale
	Mesoplodon bidens	Soweby's beaked whale
	Mesoplodon densirostris	Blainville's beaked whale
	Mesoplodon europaeus	Gervais's beaked whale
	Ziphius cavirostris	Cuvier's beaked whale
	Orcinus orca	Killer whale
	Pseudorca crassidens	False killer whale
	Feresa attenuata	Pygmy killer whale
	Globicephala macrorhynchus	Short-finned pilot whale
	Peponocephala electra	Melon-headed whale
	Grampus griseus	Risso's dolphin
	Tursiops truncatus	Bottlenose dolphin
	Steno bredanensis	Rough-toothed dolphin
	Stenella coeruleoalba	Striped dolphin
	Stenella attenuata	Pantropical spotted dolphin
	Stenella clymene	Clymene dolphin
	Stenella frontalis	Atlantic spotted dolphin
	Stenella longirostris	Spinner dolphin
	Lagenodelphis hosei	Fraser's dolphin
Pinniped	*Zalophus californianus*	California sea lion
Sirenians	*Trichechus manatus latirostris*	Florida manatee
	T. m. manatus	Antillean manatee

Source: USCG, 2002.

Table F.4-2
Nonendangered Marine and Coastal Birds of the Gulf of Mexico Region

Group	Family or Scientific Name	Common Name
Seabirds	Diomedeidae	Albatrosses
	Procellariidae	Petrels, shearwaters
	Hydrobatidae	Storm-petrels
	Sulidae	Gannets, boobies
	Phaethontidae	Tropic birds
	Pelecanidae	Pelicans
	Fregatidae	Frigate birds
	Phalacrocorcidae	Cormorants
	Scolopacidae	Phalaropes
	Laridae	Gulls, terns, noddies
	Gaviidae	Loons
Shorebirds	Haematopodidae	Oystercatchers
	Recuvirostridae	Stilts, avocets
	Scolopacidae	Sandpipers, snipes
	Charadriidae	Plovers
Marsh and wading birds	Ardeidae	Herons, egrets
	Threskiornithidae	Ibises, spoonbills
	Gruidae	Cranes
	Rallidae	Rails, moorhens, gallinules, coots
	Jacanidae	Jacanas
	Podicipedidae	Grebes
	Ciconiidae	Storks
	Anhingidae	Darters, anhingas
	Aramidae	Limlins
Waterfowl	Anatidae	Swans, ducks, geese

Source: Adapted from MMS, 2001.

Table F.4-3
National Marine Sanctuaries and National Park Units in the Gulf of Mexico Region

The National Marine Sanctuaries Program administered by NOAA was created in Title III of the Marine Protection, Research and Sanctuary Act of 1972 (33 U.S.C. 1401–1445, 16 U.S.C. 1431–1445). National Marine Sanctuaries are created to protect areas that have exhibited high levels of biodiversity, ecological integrity, and/or cultural legacy. They are the breeding and feeding grounds of whales, sea lions, sharks, and sea turtles, and contain unique marine habitats. There are two coastal or near-coastal National Marine Sanctuaries in the Gulf of Mexico region.

National Marine Sanctuary	Description
Florida Keys	This sanctuary protects 3,600 mi^2 of diverse marine ecosystems surrounding the Florida Keys, including the productive waters of Florida Bay, sand flats, seagrass meadows, mangrove-fringed shorelines and islands, and extensive living coral reefs. It includes parts of Florida Bay, the southwest continental shelf, the corals of the Florida Reef Tract that parallel the seaward edge of the Florida Keys, the Keys themselves, and the Straits of Florida.
Flower Garden Banks • East Flower Garden Bank • West Flower Garden Bank • Stetson Bank	Located 110 mi off the coasts of TX and LA, this sanctuary contains the northernmost coral reef community in the United States. The area containing both the East and West Banks equals 41.7 nm^2 in size and has 350 acres of reef crest. Stetson Bank, a salt dome, is located about 70 nm south of Galveston, TX.

continued

Table F.4-3 (*continued*)
National Marine Sanctuaries and National Park Units in the Gulf of Mexico Region

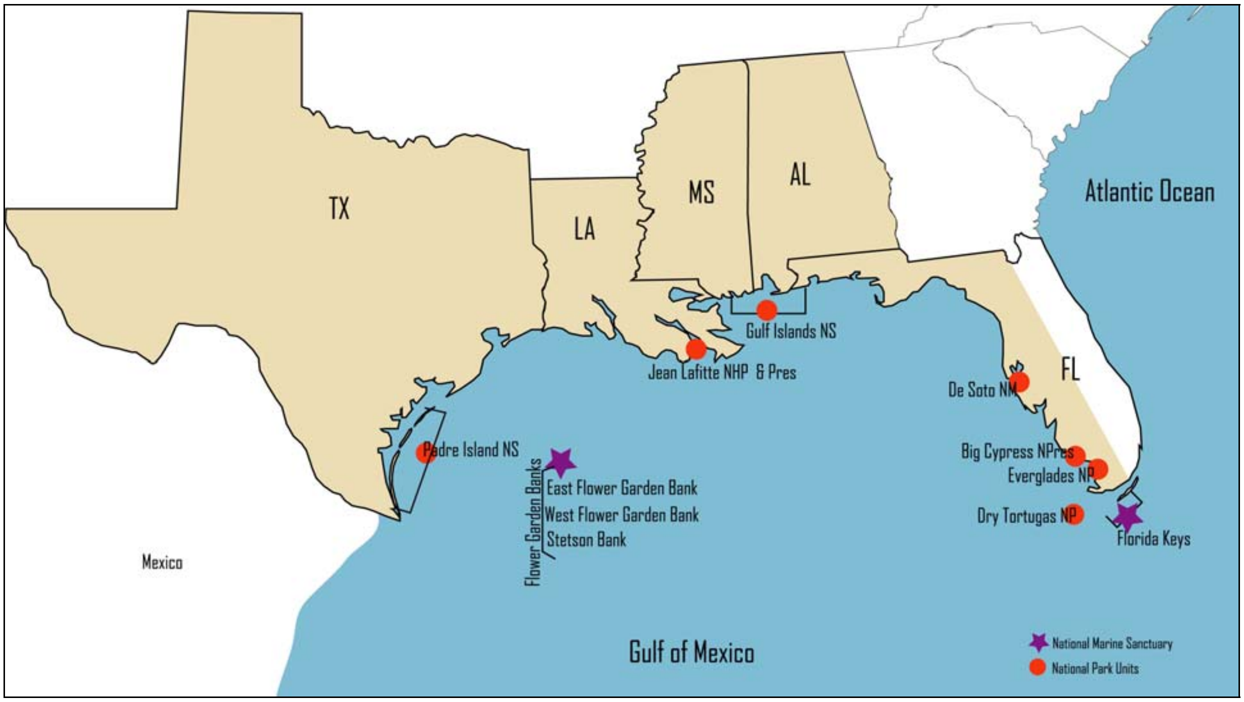
Congress established the National Park Service to ensure protection and interpretation of some of the finest examples of natural, cultural, and recreational resources. The National Park Service sets aside areas of historical and recreational value that are maintained at various stages of development, ranging from a natural pristine environment to recreational facilities and concessions. The development at any given park unit depends on the primary goal for which it was established. Park units set aside to preserve specific environments or historic locations may have localized areas developed to accommodate various uses, such as hunting, fishing, shell fishing, swimming, picnicking, hiking, camping, and boating. These uses must be compatible with the preservation of the environment or the historic location for which the park was established. There are seven coastal or near-coastal National Park units in the Gulf of Mexico region.

National Park Unit	Description
Dry Tortugas NP	Located 70 mi west of Key West, this park includes a cluster of seven islands and the surrounding shoals and waters. The area is known for its famous bird and marine life, and for Ft. Jefferson, the largest of the nineteenth-century American coastal forts.
Everglades NP	Spanning 1,509,000 acres (land and water) of the southern tip of FL and most of Florida Bay, this park is the only subtropical preserve in North America, and it contains both temperate and tropical plant communities, as well as marine and estuarine environments. The park has been designated a World Heritage Site, an International Biosphere Reserve, and a Wetland of International Importance.
Big Cypress NPres	Located to the north of Everglades NP, this 729,000-acre preserve was the first National Preserve in the National Park System and is about one-third covered with cypress trees, mostly the dwarf pond cypress variety. There is a mixture of pines, hardwoods, prairies, mangrove forests, cypress strands, and domes.
De Soto NM	This 27-acre memorial commemorates Spanish explorer Hernando de Soto, who landed on the southwest FL coast (near lower Tampa Bay) in 1539.
Gulf Islands NS	This seashore consists of eleven separate units that stretch 150 miles from West Ship Island, MS, to the eastern tip of Santa Rosa Island, FL, and encompass over 135,607 acres, making it the nation's largest National Seashore. More than 80 percent of the seashore is made up of submerged lands.
Jean Lafitte NHP and Pres	This park and preserve consists of six separate sites and a park headquarters located in southeastern LA. It was established to preserve significant examples of the rich natural and cultural resources of the Mississippi Delta region, and seeks to illustrate the influence of environment and history on the development of a unique regional culture.
Padre Island NS	Located southeast of the city of Corpus Christi, TX, on the Gulf of Mexico, this seashore encompasses 130,454 acres of the longest remaining undeveloped barrier island in the world.

Source: For National Marine Sanctuaries, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://www.sanctuaries.nos.noaa.gov/oms/oms.html,* revised January 14, 2003). For National Park units, ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: NHP, National Historical Park; NM, National Memorial; NP, National Park; NPres, National Preserve; NS, National Seashore; Pres, Preserve.

Figure F.4-1
National Marine Sanctuaries and National Park Units in the Gulf of Mexico Region



Source: For National Marine Sanctuaries, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://www.sanctuaries.nos.noaa.gov/oms/oms.html,* revised January 14, 2003). For National Park units, ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: NHP, National Historical Park; NM, National Memorial; NP, National Park; NPres, National Preserve; NS, National Seashore. Map is not to scale.

Table F.4-4
National Wildlife Refuges in the Gulf of Mexico Region

The National Wildlife Refuge System is a network of U.S. lands and waters managed specifically for the enhancement of wildlife. National Wildlife Refuges were established and are administered by the USFWS under the Fish and Wildlife Act of 1956 (16 U.S.C. 742a–742j, not including 742 d-l; 70 Stat. 1119) and the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd–668ee). These acts allow the USFWS to acquire and to administer lands for the development, advancement, management, conservation, and protection of fish and wildlife resources. Although most refuges are managed for the enhancement of resident and migratory wildlife and are available for public recreational use, such as fishing, wildlife observation, hunting, and boating, most refuges along the Gulf coast were established as wintering areas for ducks, geese, coots, and other migratory waterfowl and shorebirds. There are also refuges set aside for the protection and enhancement of specific endangered species, for example the Aransas whooping crane in TX, Mississippi sandhill crane in MS, and Crystal River manatee in FL. There are thirty-eight coastal or near-coastal National Wildlife Refuges in the Gulf of Mexico region.

National Wildlife Refuge	Description
National Key Deer Refuge Complex • Key West • National Key Deer • Great White Heron	This complex is located in the Florida Keys. Both Key West and Great White Heron are overwhelmingly marine environments: Key West covers 206,289 acres of marine waters and 189,497 acres of land, while Great White Heron includes 186,287 acres of marine waters and 6,207 acres of land. These refuges represent the last of the offshore islands in the Lower Florida Keys available as critical nesting, roosting, wading, and loafing habitat for over 250 avian species, particularly wading birds.
Florida Panther	Located east of Naples, FL, this refuge is situated in the upper segment of the Fakahatchee Strand of the Big Cypress Swamp. It contains 15,000 acres of woodland and 11,400 acres of swamp and prairie.

continued

Table F.4-4 (*continued*)
National Wildlife Refuges in the Gulf of Mexico Region

National Wildlife Refuge	Description
J. N. Ding Darling Complex • Island Bay • Pine Island • Caloosahatchee • Matlacha Pass • J. N. Ding Darling	This complex is located in southwest FL. The 20-acre Island Bay covers six undeveloped tracts of land that occupy the higher portions of several islands and mangrove shoreline. Pine Island's 548 acres are made up of seventeen islands consisting of densely forested red and black mangroves, with several islands providing important nesting and roosting areas for colonial birds, particularly the brown pelican. The 40-acre Caloosahatchee consists of several mangrove islands and is a major wintering area for the endangered Antillean manatee. Matlacha Pass's 512 acres encompass twenty-three islands that are almost exclusively vegetated by red mangroves. J. N. Ding Darling is a 6,354-acre refuge on Sanibel Island, FL.
Chassahowitzka Complex • Crystal River • Chassahowitzka • Pinellas • Egmont Key • Passage Key	This complex is located near St. Petersburg, FL. The 46-acre Crystal River aids in preserving FL's most significant naturally occurring warm water refugium for the manatee and provides critical habitat for approximately 25% of the nation's endangered Florida manatee population. Chassahowitzka's 31,000 acres provide habitat for approximately 250 species of birds, over 50 species of reptiles and amphibians, and at least 25 species of mammals; endangered and threatened species in the refuge include manatees, sea turtles, and bald eagles. The 403-acre Pinellas was established as a breeding ground for colonial bird species. Egmont Key's 350 acres include historic Ft. Dade; certain areas are designated wildlife sanctuaries to provide nesting habitat for endangered brown pelicans and other wading birds. Passage Key is a 30-acre meandering barrier island that hosts the largest royal tern and sandwich tern nesting colonies in FL.
Cedar Keys	Located southwest of Gainesville, FL, this 800-acre refuge consists of thirteen offshore islands. Four of the islands—Snake, Deadman's, Seahorse and North Keys—are designated Wilderness Areas.
Lower Suwannee	This refuge, located southeast of Chiefland, FL, protects 36,000 acres of wetlands and 16,000 acres of uplands. It also provides important habitat for wading and shore birds, migratory song birds, bald eagles, ospreys, and swallow-tailed kites.
St. Marks	Established to provide wintering habitat for migratory birds, this refuge is one of the oldest in the system and encompasses 68,000 acres spread along the Gulf coast of northwest FL. The refuge includes coastal marshes, islands, tidal creeks, and estuaries of seven north FL rivers.
St. Vincent	Located southwest of Apalachicola, FL, this 12,490-acre refuge is an undeveloped coastal barrier island with representative native plants and animals. It is a migratory bird stop, nesting site for bald eagles and loggerhead sea turtles, and propagation site for the red wolf.
Gulf Coast Complex • Bon Secour • Grand Bay • Mississippi Sandhill Crane	Located near Gulf Shores, AL, the 6,700-acre Bon Secour was established to protect some of the last remaining undisturbed coastal barrier habitat along the AL Gulf coast. Grand Bay spreads across 14,000 acres in Jackson County, MS, and Mobile County, AL, with major habitats consisting of tidal marsh in the southern portion and pine/pine savanna in the central and northern portions. The 19,000-acre Mississippi Sandhill Crane was established to safeguard the critically endangered Mississippi sandhill crane and its unique disappearing habitat.
Southeast Louisiana Refuges • Bogue Chitto • Big Branch Marsh • Bayou Sauvage • Breton • Delta • Shell Keys	The 40,000-acre Bogue Chitto is a bottomland hardwood forest that is home to more than 150 species of birds and 40 species of mammals. Big Branch Marsh encompasses 12,000 acres of marshes along the north shore of Lake Pontchartrain and provides habitat for numerous endangered red-cockaded woodpecker colonies. Located within the city limits of New Orleans, LA, and encompassing approximately 23,000 acres, Bayou Sauvage is the largest urban National Wildlife Refuge in the United States and is one of the last remaining marsh areas adjacent to Lakes Pontchartrain and Borgne. Breton is the second oldest refuge in the system and is made up of a series of barrier islands covering approximately 18,200 acres. Delta covers 48,800 acres of marsh, shallow ponds, channels, and bayous and provides a winter haven for migratory waterfowl. Shell Keys is a bird sanctuary that is composed of a few small shell spits or islands that are continually built up, eroded, and moved by storm events. The complex also includes Atchafalaya National Wildlife Refuge, located west of Baton Rouge, LA.

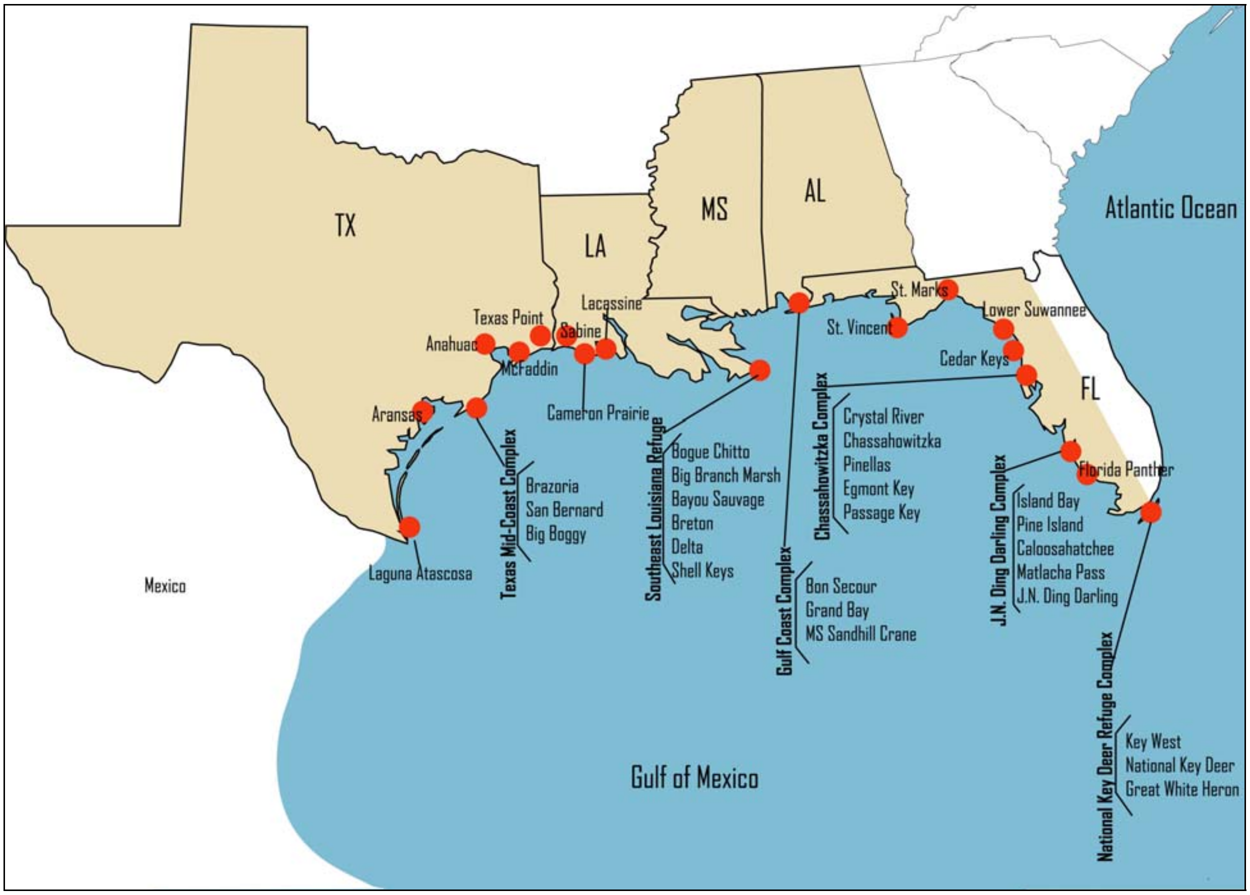
continued

Table F.4-4 (*continued*)
National Wildlife Refuges in the Gulf of Mexico Region

National Wildlife Refuge	Description
Lacassine	Located southwest of Lake Arthur, LA, this nearly 35,000-acre refuge is mostly freshwater marsh habitat. It preserves one of the major wintering grounds for waterfowl in the United States; wintering populations of ducks and geese at the refuge are among the largest in the system.
Cameron Prairie	During winter months, over 45,000 ducks and 10,000 geese inhabit this refuge, which encompasses over 9,600 acres southeast of Lake Charles, LA.
Sabine	This approximately 124,500-acre refuge occupies the marshes between Calcasieu and Sabine Lakes in southwest LA. There are concentrations of ducks, geese, alligators, muskrats, nutria, raptors, wading birds, shorebirds, blue crabs, and shrimp; olivaceous cormorant, snowy egret and common egret rookeries are also present.
Texas Point	Located on the upper TX coast, this refuge encompasses 8,900 acres of fresh to salt marsh with some wooded uplands and prairie ridges. Along with neighboring McFaddin National Wildlife Refuge, Texas Point supplies important feeding and resting areas for migrating and wintering populations of waterfowl.
McFaddin	Located on the upper TX coast, this 55,000-acre refuge protects one of the largest remaining freshwater marshes on the TX coast and thousands of acres of intermediate to brackish marsh. Along with neighboring Texas Point National Wildlife Refuge, McFaddin supplies important feeding and resting areas for migrating and wintering populations of waterfowl.
Anahuac	This 34,000-acre refuge on the northeastern edge of Galveston Bay, TX provides wintering and migration habitat for ducks and geese of the Central Flyway, as well as for other migratory bird species.
Texas Mid-Coast Complex • Brazoria • San Bernard • Big Boggy	Located near Houston, TX, this coastal wetlands harbors more than 300 bird species, and serves as an end point for waterfowl of the Central Flyway in winter and as an entry point for neotropical migratory song birds of the 600-mi Gulf crossing from Mexico's Yucatan Peninsula. Brazoria encompasses over 43,300 acres; San Bernard, 27,000 acres; and Big Boggy, 5,000 acres.
Aransas	This 70,504-acre refuge is made up of the Blackjack Peninsula, along the south central coast of TX named for its scattered blackjack oaks. Grasslands, live oaks, and redbay thickets cover deep, sandy soils. The refuge is winter home for endangered whooping crane, alligators, deer, and many other species of wildlife.
Laguna Atascosa	This southern TX refuge is the largest protected area of natural habitat left in the Lower Rio Grande Valley, covering 45,000 acres. It blends temperate, subtropical, coastal, and desert habitats, with Mexican plants and wildlife at the northernmost edge of their range and migrating waterfowl and sandhill cranes down for the mild winters.

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Figure F.4-2
National Wildlife Refuges in the Gulf of Mexico Region



Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Note: Map is not to scale.

Table F.4-5
National Estuarine Research Reserves and National Estuary Programs in the Gulf of Mexico Region

The National Estuarine Research Reserve Program was established by the Coastal Zone Management Act of 1972 (16 U.S.C. 1451–1464) and is administered by the Sanctuaries and Reserves Division, National Oceanic and Atmospheric Administration. A primary objective of Congress in establishing the estuarine research-reserve program is to provide information to be used by coastal managers and fishing industries by providing research information that will help assure the continued productivity of estuarine ecosystems. The Coastal Zone Management Act of 1972, as amended, established the National Estuarine Sanctuary Program to provide financial assistance awards on a matching basis to states to acquire, develop, and operate estuarine areas as natural field laboratories. The purpose of the program is to provide long-term protection to vital habitats for estuarine-dependent life, thus preserving relatively unaltered estuarine areas for baseline scientific research and educational programs. There are three coastal or near-coastal National Estuarine Research Reserves in the Gulf of Mexico region.

National Estuarine Research Reserve	Description
Rookery Bay	Located at the northern end of the Ten Thousand Islands on the Gulf coast of FL, this 110,000-acre reserve represents one of the few remaining undisturbed mangrove estuaries in North America. Many threatened and endangered animals and 150 species of birds thrive within the reserve, which also includes mangroves, open bays, creeks, pine flats, hardwood hammocks, oyster reefs, and seagrass beds.
Apalachicola Bay	This 246,000-acre reserve is one of the most productive estuarine systems in the Northern Hemisphere. Located on the Florida Panhandle, the reserve features 1,162 subspecies of vascular plants, 308 species of birds, 186 species of fish, and 57 species of mammals. It has the largest natural stand of tupelo trees in the world.
Weeks Bay	Located between Mobile, AL, and Pensacola, FL, this 6,000-acre reserve encompasses open shallow waters, with an average depth of less than 5 ft, and extensive vegetated wetland areas. Weeks Bay is a critical nursery for shrimp, bay anchovy, blue crab and multitudes of other fish, crustaceans and shellfish.

In 1987, the NEP was established by the Water Quality Act (P.L. 100-4) and is administered by USEPA. The purposes of the program are to identify nationally significant estuaries, protect and improve their water quality, and enhance their living resources. Under the administration of USEPA, comprehensive management plans are generated to protect and enhance environmental resources of estuaries designated to be of national importance. The governor of a state may nominate an estuary for the program and request that a Comprehensive Conservation and Management Plan be developed. Over a 5-year period, representatives from federal, state, and interstate agencies; academic and scientific institutions, and industry and citizen groups do the following: (1) define objectives for protecting the estuary, (2) select the chief problems to be addressed in the plan, and (3) ratify a pollution control and resource management strategy to meet each objective. Strong public support and subsequent political commitments are needed to accomplish the actions called for in the plan. There are seven coastal or near-coastal National Estuary Programs in the Gulf of Mexico region.

National Estuary Program	Description
Charlotte Harbor	Located on the FL west coast, Charlotte Bay is the second largest open-water estuary in the state, with a total area of 270 mi^2. It serves as a home, feeding ground, and/or nursery area for more then 270 species of resident, migrant, and commercial fishes of the Gulf of Mexico. Manatees, sea turtles, wood storks, and dolphins are also found in the estuary and its watershed.
Sarasota Bay	This 283-mi^2 estuary is located on the FL west coast. Much of the bay's habitat for young fish was destroyed as the natural mangrove shoreline was replaced by concrete sea walls during development of waterfront communities. Since most sea walls cannot be removed without causing severe damage to homes, different styles of small artificial reefs attached to sea walls are being tested for their ability to provide a home for young fish.
Tampa Bay	Located on the FL west coat, Tampa Bay is the largest open-water estuary in Florida, with a total area of 398 mi^2. As many as 40,000 pairs of birds nest in Tampa Bay every year. The bay is also home to dolphins, sea turtles, and manatees.
Mobile Bay	Mobile Bay's 44,500-mi^2 watershed includes over two-thirds of AL and portions of GA, TN, and MS, making it the nation's sixth largest in area and fourth largest in discharge volume.

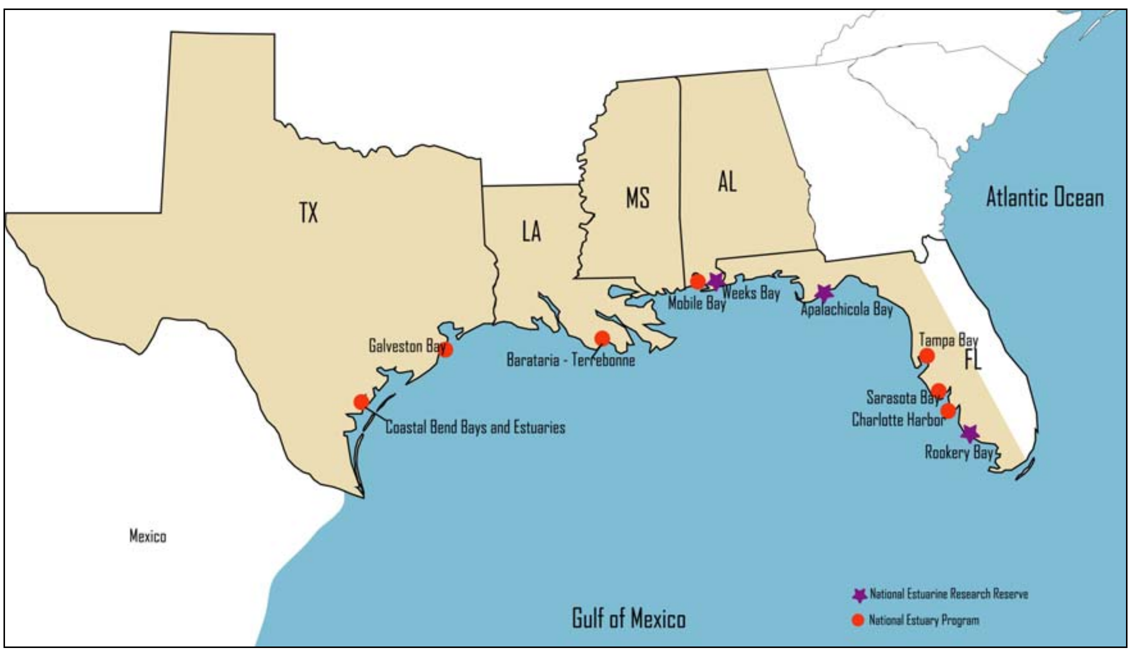
continued

Table F.4-5 (*continued*)
National Estuarine Research Reserves and National Estuary Programs in the Gulf of Mexico Region

National Estuary Program	Description
Barataria-Terrebonne	Located between the Mississippi and Atchafalaya Rivers in south LA, this 4-million acre estuary system is separated by the Bayou Lafourche into two basins, Barataria Basin to the east and Terrebonne Basin to the west. It contains more coastal wetlands than any other estuarine system in the United States. Approximately 735 species of birds, finfish, shellfish, reptiles, amphibians, and mammals spend all or part of their life cycle in the estuary.
Galveston Bay	This estuary is the seventh largest estuary in the United States and the largest in TX, with a watershed covering more than 24,400 mi^2. The slow gradients of fresh to saline wetlands and open waters provide great habitat variety and ideal conditions for the growth of fish, crabs, shrimp, and oysters.
Coastal Bend Bays and Estuaries	The twelve counties of this estuarine system encompass an area of 11,500 mi^2, with 515 mi^2 of bays and estuaries. Rapid population growth in the coastal areas of south TX has led to problems in this estuary system, including the decline of aquatic and wildlife populations, loss of wetlands and other coastal habitats, degradation of water quality, changes in circulation patterns, increasing sources of marine debris, and changes in freshwater flowing into the bay system.

Source: For National Estuarine Research Reserves, Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://nerrs.noaa.gov/Reserves.html,* revised September 25, 2003). For National Estuary Programs, Office of Water, U.S. Environmental Protection Agency (*http://www.epa.gov/owow/estuaries/find.htm*, updated February 25, 2003).

Figure F.4-3
National Estuarine Research Reserves and National Estuary Programs in the Gulf of Mexico Region



Source: For National Estuarine Research Reserves, Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://nerrs.noaa.gov/Reserves.html,* revised September 25, 2003). For National Estuary Programs, Office of Water, U.S. Environmental Protection Agency (*http://www.epa.gov/owow/estuaries/find.htm*, updated February 25, 2003).

Note: Map is not to scale.

Table F.4-6
Coastal County*/Parish Population of the Gulf of Mexico Region

State	County/Parish	Population	State	County/Parish	Population
GA	Decatur	28,240	FL (west coast)	Wakulla	22,863
	Grady	23,659		Walton	40,601
	Thomas	42,737		Washington	20,973
FL (west coast)	Bay County	148,217	AL	Baldwin	140,415
	Calhoun	13,017		Clarke	27,867
	Charlotte	141,627		Covington	37,631
	Citrus	118,085		Escambia	38,440
	Collier	251,377		Geneva	25,764
	De Soto	32,209		Mobile	399,843
	Dixie	13,827		Monroe	24,324
	Escambia	294,410		Washington	18,097
	Franklin	11,057	MS	Amite	13,599
	Gadsden	45,087		George	19,144
	Gilchrist	14,437		Hancock	42,967
	Glades	10,576		Harrison	189,601
	Gulf	13,332		Jackson	131,420
	Hardee	26,938		Lamar	39,070
	Hernando	130,802		Marion	25,595
	Hillsborough	998,948		Pearl River	48,621
	Holmes	18,564		Pike	38,940
	Jackson	46,755		Stone	13,622
	Jefferson	12,902		Walthall	15,156
	Lafayette	7,022		Wilkinson	10,312
	Lee	440,888	LA	Acadia	58,861
	Leon	239,452		Ascension	76,627
	Levy	34,450		Assumption	23,388
	Liberty	7,021		Avoyelles	41,481
	Madison	18,733		Beauregard	32,986
	Manatee	264,002		Calcasieu	183,577
	Glades	10,576		Cameron	9,991
	Marion	258,916		East Baton Rouge	412,852
	Monroe	79,589		East Feliciana	21,360
	Okaloosa	170,498		Evangeline	35,434
	Pasco	344,765		Iberia	73,266
	Pinellas	921,482		Iberville	33,320
	Polk	483,924		Jefferson	455,466
	Santa Rosa	117,743		Jefferson Davis	31,435
	Sarasota	325,957		Lafayette	190,503
	Sumter	53,345		Lafourche	8,974
	Suwannee	34,844		Livingston	91,814
	Taylor	19,256		Orleans	484,674

continued

Table F.4-6 (*continued*)
Coastal County*/Parish Population of the Gulf of Mexico Region

State	County/Parish	Population	State	County/Parish	Population
LA	Plaquemines	26,757	TX	Fayette	21,804
	Pointe Coupee	22,763		Fort Bend	354,452
	Rapides	126,337		Galveston	250,158
	Sabine	23,459		Goliad	6,928
	St. Bernard	67,229		Harris	3,400,578
	St. Charles	48,072		Hidalgo	569,463
	St. Helena	10,525		Jackson	14,391
	St. James	21,216		Jasper	35,604
	St. John the Baptist	43,044		Jefferson	252,051
	St. Landry	87,700		Jim Hogg	5,281
	St. Martin	48,583		Jim Wells	39,326
	St. Mary	53,500		Kenedy	414
	St. Tammany	191,268		Kleberg	31,549
	Tangipahoa	100,588		Lavaca	19,210
	Terrebonne	104,503		Liberty	70,154
	Vermilion	53,807		Live Oak	12,309
	Vernon	52,531		Matagorda	37,957
	Washington	43,926		Newton	15,072
	West Baton Rouge	21,601		Nueces	313,645
	West Feliciana	15,111		Orange	84,966
TX	Aransas	22,497		Refugio	7,828
	Austin	23,590		San Patricio	67,138
	Bee	32,359		Starr	53,597
	Brazoria	241,767		Tyler	20,871
	Brooks	7,976		Victoria	84,088
	Calhoun	20,647		Waller	32,663
	Cameron	335,227		Washington	30,373
	Chambers	26,031		Webb	193,117
	Colorado	20,390		Wharton	41,188
	De Witt	20,013		Willacy	20,082
	Duval	13,120			

Source: U.S. Census Bureau, 2000

* The Office of Ocean Resources, Conservation and Assessment (ORCA), National Ocean Service (NOS), National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce classifies counties as coastal "because they meet one of the following criteria: (1) at least 15 percent of their total land area is located within the nation's coastal watersheds (as defined by ORCA's Coastal Assessment Framework [*http://spo.nos.noaa.gov/projects/caf/caf.html*, page not dated], or (2) the county accounts for at least 15 percent of the land area of a coastal cataloging unit (a U.S. Geological Survey-defined drainage basin)" (*http://spo.nos.noaa.gov/projects/population/population.html*, page not dated). The U.S. Bureau of the Census also uses ORCA's coastal counties list.

F.5. PACIFIC REGION

Table F.5-1
Nonendangered Marine Mammals of the Pacific Region

Group	Scientific Name	Common Name
Cetaceans	*Balaenoptera acutorostrata*	Minke whale
	Eschrichtius robustus	California gray whale
	Globicephala macrorhynchus	Short-finned pilot whale
	Orcinus orca	Killer whale
	Pseudorca crassidens	False Killer whale
	Kogia breviceps	Pygmy sperm whale
	Kogia simus	Dwarf sperm whale
	Ziphius cavirostris	Cuvier's beaked whale
	Berardius bairdii	Baird's beaked whale
	Mesoplodon carlhubbsi	Hubb's beaked whale
	Delphinus delphis	Short-beaked common dolphin
	D. capensis	Long-beaked common dolphin
	Tursiops truncatus	Bottlenose dolphin
	Stenella coeruleoalba	Striped dolphin
	Grampus griseus	Risso's dolphin
	Lagenorhynchus obliquidens	Pacific white-sided dolphin
	Lissodelphis borealis	Northern right whale dolphin
	Phocoenoides dalli	Dall's porpoise
	Phocoena phocoena	Harbor porpoise
Pinnipeds	*Callorhinus ursinus*	Northern fur seal
	Mirounga angustirostris	Northern elephant seal
	Phoca vitulina	Harbor seal
	Zalophus californianus	California sea lion
Fissiped	*Enhydra lutris nereis*	Southern sea otter

Source: USCG, 2002.

Table F.5-2
Nonendangered Marine and Coastal Birds of the Pacific Region

Group	Family Name	Common Name
Seabirds	Procellariidae	Petrels, shearwaters, fulmars
	Hydrobatidae	Storm petrels
	Laridae	Gulls
	Scolopacidae	Phalaropes
	Alcidae	Murres, murrelets, puffins, auklets
	Pelicanidae	Pelicans
	Laridae	Terns
	Phalacrocoracidae	Cormorants
Shorebirds	Charadriidae	Plovers
	Scolopacidae	Whimbrels, Willet godwits, sanderlings, sandpipers, turnstones, surfbirds
	Recuvirostridae	Avocets
	Haematopodidae	Oystercatchers
Marsh and wading birds	Ardeidae	Herons, egrets
	Rallidae	Rails
Waterfowl	Anatidae	Ducks, geese

Source: Adapted from MMS, 1996.

Table F.5-3
National Marine Sanctuaries and National Park Units in the Pacific Region

The National Marine Sanctuaries Program administered by the NOAA was created in Title III of the Marine Protection, Research and Sanctuary Act of 1972 (33 U.S.C. 1401–1445, 16 U.S.C. 1431–1445). National Marine Sanctuaries are created to protect areas that have exhibited high levels of biodiversity, ecological integrity, and/or cultural legacy. They are the breeding and feeding grounds of whales, sea lions, sharks, and sea turtles, and contain unique marine habitats. There are five coastal or near-coastal National Marine Sanctuaries in the Pacific region.

National Marine Sanctuary	Description
Channel Islands	Located 22 nm off the coast of Santa Barbara, CA, in the Southern California Bight, this sanctuary protects approximately 1,658 mi^2 of water surrounding Anacapa, Santa Cruz, Santa Rosa, San Miguel, and Santa Barbara Islands. It contains extensive kelp beds, fish, and shellfish that are highly valued by commercial and sport fishermen, and provides habitat for breeding seabirds, including the endangered brown pelican.
Monterey Bay	Encompassing the waters of Monterey Bay and adjacent Pacific Ocean off the central CA coast, this vast sanctuary stretches 400 mi north to south, extends an average 30 nm offshore, and covers over 5,300 mi^2. It is characterized by extremely rich flora and fauna caused by diverse oceanic conditions and undersea topography, including the most diverse algal community in the United States.
Gulf of the Farallones	This 1,255-mi^2 sanctuary is located in nearshore and offshore waters just north and west of San Francisco Bay, CA, contains thousands of seals and sea lions, and is home to the largest concentration of breeding seabirds in the continental United States.
Cordell Bank	Centered on the Cordell Bank plateau, this sanctuary is 45 nm northwest of San Francisco Bay, CA, and encompasses an area of approximately 526 mi^2. It is one of the most important feeding grounds in the world for the endangered blue and humpback whales and is known as the "albatross capital of the northern hemisphere."
Olympic Coast	This sanctuary covers over 3,300 mi^2 of ocean waters off central and northern WA. Sanctuary waters extend an average of 30 nm offshore and span 135 mi north to south. This nearly pristine ocean and coastal environment supports numerous species of marine mammals and one of the largest seabird colonies in the continental United States.

continued

Table F.5-3 (*continued*)
National Marine Sanctuaries and National Park Units in the Pacific Region

Congress established the National Park Service to ensure protection and interpretation of some of the finest examples of natural, cultural, and recreational resources. The National Park Service sets aside areas of historical and recreational value that are maintained at various stages of development, ranging from a natural pristine environment to recreational facilities and concessions. The development at any given park unit depends on the primary goal for which it was established. Park units set aside to preserve specific environments or historic locations may have localized areas developed to accommodate various uses, such as hunting, fishing, shell fishing, swimming, picnicking, hiking, camping, and boating. These uses must be compatible with the preservation of the environment or the historic location for which the park was established. There are five coastal or near-coastal National Park units in the Pacific region.

National Park Unit	Description
Channel Islands NP	The park consists of 249,354 acres, half of which are under the ocean, and includes San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara Islands off of CA.. Over 2,000 species of plants and animals can be found within the park; however, only four mammals are endemic to the islands. One hundred and forty-five of these species are unique to the islands and found nowhere else in the world.
Golden Gate NRA	This recreation area is the largest urban national park in the world with 75,398 acres of land and water and 28 mi of coastline. Located in San Francisco, CA, it comprises numerous sites, including Alcatraz, the Presidio of San Francisco, and several forts.
Point Reyes NS	Located north of San Francisco, CA, this seashore comprises over 100 mi^2, including 32,000 acres of coastal Wilderness Area. Estuaries, beaches, coastal scrub grasslands, salt and freshwater marshes, and coniferous forests make up 80 mi of undeveloped coastline. Over 45 percent of North American avian species and nearly 18 percent of CA plant species are found here because of the habitat and geology. Twenty-three threatened and endangered species exist within the seashore. It has been designated a part of the Central California Coast Biosphere Reserve.
Redwood NSP	Located in northern CA below the OR border, this park contains 12,613 acres of federal and state lands, including 37 mi of coastline, and consists of Prairie Creek Redwoods State Park, Del Norte Coast Redwoods State Park, Jedediah Smith Redwoods State Park, and Redwood NP. Together, these four parks are recognized as both a World Heritage Site and an International Biosphere Reserve, and they comprise 45 percent of all old-growth redwood forest remaining in CA. This park is also a testing ground for large-scale forest and stream restoration of severely impacted lands.
Olympic NP	Located in northwestern WA, this park contains over 60 mi of wild Pacific coast, the largest section of wilderness coast in the lower 48 states. About 95 percent of the park is designated wilderness, and the largest undisturbed old-growth and temperate rain forests in the Northwest are found here. In addition, eight kinds of plants and fifteen kinds of animals are found on the Olympic Peninsula but nowhere else on earth.

Source: For National Marine Sanctuaries, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://www.sanctuaries.nos.noaa.gov/oms/oms.html,* revised January 14, 2003). For National Park units, ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: NP, National Park; NRA, National Recreation Area; NS, National Seashore; NSP, National and State Parks.

Figure F.5-1
National Marine Sanctuaries and National Park Units in the Pacific Region

Source: For National Marine Sanctuaries, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://www.sanctuaries.nos.noaa.gov/oms/oms.html,* revised January 14, 2003). For National Park units, ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: NP, National Park; NRA, National Recreation Area; NS, National Seashore; NSP, National and State Parks. Map is not to scale.

Table F.5-4
National Wildlife Refuges in the Pacific Region

The National Wildlife Refuge System is a network of U.S. lands and waters managed specifically for the enhancement of wildlife. National Wildlife Refuges were established and are administered by the USFWS under the Fish and Wildlife Act of 1956 (16 U.S.C. 742a–742j, not including 742 d-l; 70 Stat. 1119) and the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd–668ee). These acts allow the USFWS to acquire and to administer lands for the development, advancement, management, conservation, and protection of fish and wildlife resources. Although most refuges are managed for the enhancement of resident and migratory wildlife and are available for public recreational use, such as fishing, wildlife observation, hunting, and boating, refuges along the Pacific coast were established as wintering areas for ducks, geese, terns, and other migratory waterfowl and shorebirds. Threatened and endangered species such as the bald eagle, California least tern, California brown pelican, and sea otters also enjoy protected sanctuary on refuges along the Pacific coast. There are twenty-eight coastal or near-coastal National Wildlife Refuges in the Pacific region.

National Wildlife Refuge	Description
San Diego Complex • South San Diego Bay • San Diego • Seal Beach • Sweetwater Marsh • Tijuana Slough	This series of small refuges were established to preserve and protect the rare birds of southern California's coastal marshes. The complex protects larger areas of open space in the coastal uplands, rare vernal pool wetlands, and in San Diego Bay. All refuges in the Complex have been designated "Globally Important Bird Areas" by the American Bird Conservancy; South San Diego Bay was recently designated as a Western Hemisphere Shorebird Reserve site.
Don Edwards San Francisco Bay Complex • Marin Islands • Farallon • San Pablo Bay • Antioch Dunes • Ellicott Slough • Salinas River	As the first urban National Wildlife Refuge established in the United States, this complex spans 23,000 acres of open bay, salt pond, salt marsh, mudflat, upland, and vernal pool habitats located throughout south San Francisco Bay. Located along the Pacific Flyway, the complex hosts over 280 species of birds each year and provides critical habitat to resident species like the endangered California clapper rail and salt marsh harvest mouse.
Humboldt Bay	This 2,200-acre refuge located in northern CA protects wetlands and bay habitats for migratory birds, especially black brant. The refuge includes the Lanphere Dunes, one of the most pristine remaining dune ecosystems in the Pacific Northwest, and the largest remaining eelgrass beds south of Willapa Bay, WA.
Oregon Coast Complex • Three Arch Rocks • Cape Meares • Nestucca Bay • Oregon Islands • Siletz Bay • Bandon Marsh	This complex spans 320 mi of OR coastline, stretching from Tillamook Head, OR, south to the CA border. Three Arch Rocks, Cape Meares, and Oregon Islands are marine refuges that protect coastal rocks, reefs, islands, and several headland areas; these habitats support some of the most important seabird nesting colonies in the United States, including common murres, tufted puffins, cormorants, and storm petrels. Nestucca Bay, Siletz Bay, and Bandon Marsh are estuarine reserves that preserve saltmarsh, brackish marsh, riparian wetland, and wooded upland habitats.
Lewis and Clark	This refuge includes 8,313 acres of islands and sand bars in the Columbia River estuary, plus 35,000 acres of mostly tidelands and open water. Located near Astoria, OR, it provides wintering and resting areas for up to 1,000 tundra swans, 5,000 geese, and 30,000 ducks.
Julia Butler Hansen	Located in Cathlamet, WA, this refuge consists of 4,757 acres of diked Columbia River floodplain and undiked islands. It provides critical habitat for the endangered Columbian white-tailed deer.
Willapa	This 11,000-acre refuge is located in Pacific County, the southernmost coastal county in WA. Land varies from sand dunes, sand beaches, and mud flats to grasslands, saltwater and fresh marshes, and coniferous forest.
Grays Harbor	Located west of Hoquiam, WA, this 1,800-acre refuge is composed of tidal flats, salt marsh, freshwater ponds, and deciduous woodland. It is one of four major staging areas for shorebirds in North America, and the Western Hemisphere Shorebird Reserve Network designated it a hemispheric reserve as a site of international significance.

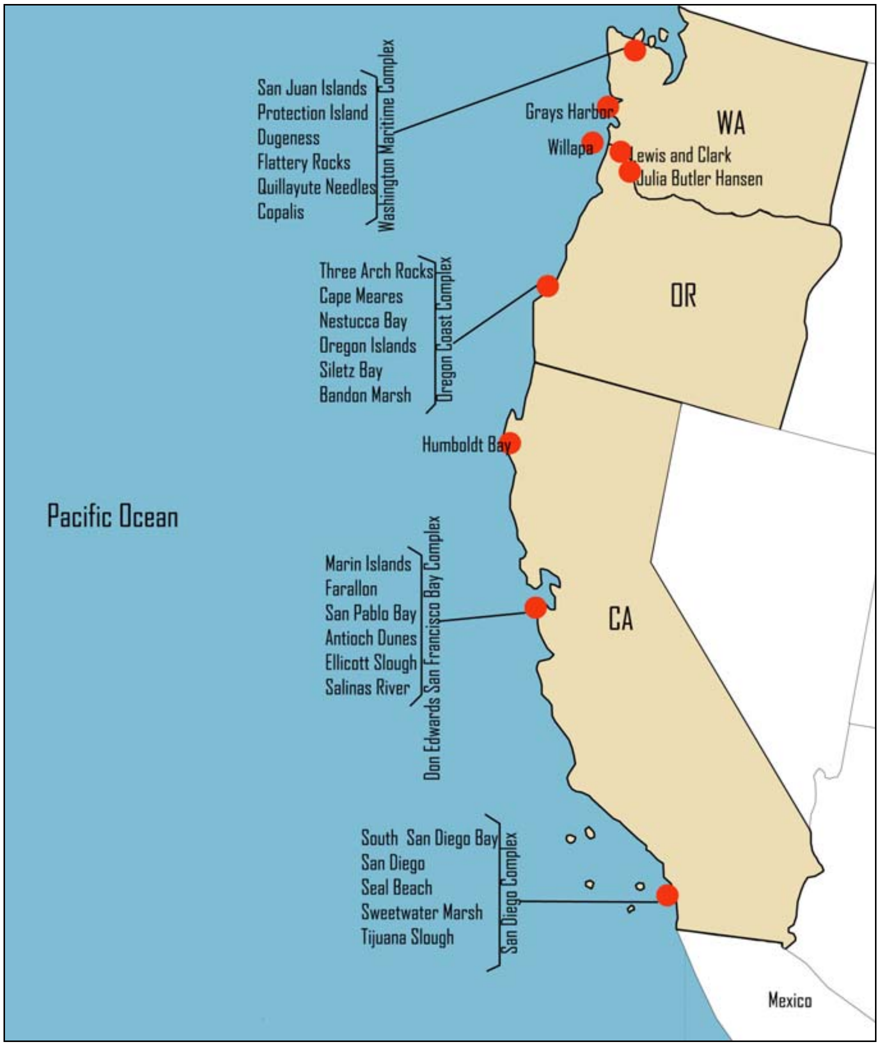
continued

Table F.5-4 (*continued*)
National Wildlife Refuges in the Pacific Region

National Wildlife Refuge	Description
Washington Maritime Complex • San Juan Islands • Protection Island • Dungeness • Flattery Rocks • Quillayute Needles • Copalis	Located in northern Puget Sound, the 454-acre San Juan Islands are a group of eighty-three islands with reef, rock, grassy island, and forested island habitats. The 364-acre Protection Island is located at the mouth of Discovery Bay in the Strait of Juan de Fuca, and it is closed to the public to protect nesting seabirds and harbor seals. The world's longest natural sand spit, Dungeness, encompasses 631 acres and is located near Sequim, WA. Flattery Rocks, Quillayute Needles, and Copalis stretch over 100 mi of WA Pacific Ocean coastline and include 870 coastal rocks and reefs.

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Figure F.5-2
National Wildlife Refuges in the Pacific Region



Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Note: Map is not to scale.

Table F.5-5
National Estuarine Research Reserves and National Estuary Programs in the Pacific Region

The National Estuarine Research Reserve Program was established by the Coastal Zone Management Act of 1972 (16 U.S.C. 1451–1464) and is administered by the Sanctuaries and Reserves Division, NOAA. A primary objective of Congress in establishing the estuarine research-reserve program is to provide information to be used by coastal managers and fishing industries by providing research information that will help assure the continued productivity of estuarine ecosystems. The Coastal Zone Management Act of 1972, as amended, established the National Estuarine Sanctuary Program to provide financial assistance awards on a matching basis to states to acquire, develop, and operate estuarine areas as natural field laboratories. The purpose of the program is to provide long-term protection to vital habitats for estuarine-dependent life, thus preserving relatively unaltered estuarine areas for baseline scientific research and educational programs. There are four coastal or near-coastal National Estuarine Research Reserves in the Pacific region.

National Estuarine Research Reserve	Description
Tijuana River	Located in San Diego County, CA, on the Mexican border, this intertidal coastal estuary is primarily a shallow water habitat, though it is often termed an "intermittent estuary." The reserve encompasses approximately 2,500 acres and is home to eight threatened and endangered species.
Elkhorn Slough	Located midway between the coastal towns of Santa Cruz and Monterey, CA, this 1,400-acre reserve is one of the relatively few undisturbed coastal wetlands remaining in CA. The main channel of the slough winds inland nearly 7 mi and is flanked by a broad salt marsh second in size only to San Francisco Bay.
South Slough	A 4,700-acre natural area encompassing 600 acres of tidal marshes, mudflats, and open water channels, this reserve connects to the ocean through the Coos estuary mouth, near Charleston, OR. It includes upland forests, freshwater wetlands and ponds, salt marshes, tidal floats, eelgrass meadows, and open water habitats.
Padilla Bay	Located on North Puget Sound near Anacortes, WA, this 11,000-acre reserve encompasses extensive seagrass meadows, tidal flats and sloughs, salt marshes, and upland forests and mangroves. Padilla Bay is an estuary at the saltwater edge of the large delta of the Skagit River. It is about 8 mi long and 3 mi across and contains nearly 8,000 acres of eelgrass.

In 1987, the NEP was established by the Water Quality Act (P.L. 100-4) and is administered by USEPA. The purposes of the program are to identify nationally significant estuaries, protect and improve their water quality, and enhance their living resources. Under the administration of USEPA, comprehensive management plans are generated to protect and enhance environmental resources of estuaries designated to be of national importance. The governor of a state may nominate an estuary for the program and request that a Comprehensive Conservation and Management Plan be developed. Over a 5-year period, representatives from federal, state, and interstate agencies; academic and scientific institutions, and industry and citizen groups do the following: (1) define objectives for protecting the estuary, (2) select the chief problems to be addressed in the plan, and (3) ratify a pollution control and resource management strategy to meet each objective. Strong public support and subsequent political commitments are needed to accomplish the actions called for in the plan. There are six coastal or near-coastal National Estuary Programs in the Pacific region.

National Estuary Program	Description
Santa Monica Bay	Located off the west coast of Los Angeles, CA, this bay has 306 mi^2 of surface water and 414 mi^2 of watershed. Habitats types include terrestrial, wetland, and rocky intertidal areas. Kelp beds and coastal scrub are also found in the bay, which is home to many threatened or endangered species.
Morro Bay	Located between Los Angeles Harbor and San Francisco Bay in CA, Morro Bay is the largest of relatively unaltered bays; it is actually a lagoon or shallow sound. The 2,300-acre bay and its 48,000-acre watershed include salt marsh, tidal mudflats, and open water habitats.
San Francisco Bay	As the largest estuary on the western seaboard, the bay has a surface area of approximately 1,600 mi^2 and a watershed area of 60,000 mi^2, which is 40% of the total area of CA. Water in the bay has huge salinity range. Habitats include open water, intertidal mudflats, rocky shores, salt ponds, marshes (salt, brackish, and freshwater), riparian forests, and vernal pools.
Tillamook Bay	Located along the northern Pacific coastline of OR, Tillamook Bay has a surface area of 11 mi^2 and a watershed area of 5,70 mi^2. Five rivers largely supply the fresh water in the bay. Habitats include intertidal flats, salt marsh, mud flats, seagrasses, and eelgrass.
Lower Columbia River	Beginning in Canada and traveling down along the WA and OR coasts, the Lower Columbia River has a 259,000-mi2 watershed, and the program covers 146 mi from the mouth of the river to Bonneville Dam. The river has the second largest volume of flow of any river in the United States. Hundreds of species, including 175 species of birds, use the lower river and estuary as permanent or migratory habitat.

continued

Table F.5-5 (*continued*)
National Estuarine Research Reserves and National Estuary Programs in the Pacific Region

National Estuary Program	Description
Puget Sound	Surrounded by 2,500 mi of WA shoreline, Puget Sound has a surface area of 931 mi2 and a watershed area of 16,000 mi^2. Habitat types include open water, islands, beaches, bluffs, deltas, mudflats, and wetlands. The sound is home to more than 220 fish species; 26 marine mammal species; and 100 seabirds, shorebirds, and waterfowl species.

Source: For National Estuarine Research Reserves, Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://nerrs.noaa.gov/Reserves.html,* revised September 25, 2003). For National Estuary Programs, Office of Water, U.S. Environmental Protection Agency (*http://www.epa.gov/owow/estuaries/find.htm*, updated February 25, 2003).

Figure F.5-3
National Estuarine Research Reserves and National Estuary Programs in the Pacific Region

Source: For National Estuarine Research Reserves, Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://nerrs.noaa.gov/Reserves.html,* revised September 25, 2003). For National Estuary Programs, Office of Water, U.S. Environmental Protection Agency (*http://www.epa.gov/owow/estuaries/find.htm*, updated February 25, 2003).

Note: Map is not to scale.

Table F.5-6
Coastal County* Population of the Pacific Region

State	County	Population	State	County	Population
CA	Alameda	1,443,741	OR	Clackamas	338,391
	Contra Costa	948,816		Clatsop	35,630
	Del Norte	27,507		Columbia	43,560
	Humboldt	126,518		Coos	62,779
	Los Angeles	9,519,338		Curry	21,137
	Marin	247,289		Douglas	100,399
	Mendocino	86,265		Josephine	75,726
	Monterey	401,762		Lane	322,959
	Napa	124,279		Lincoln	44,479
	Orange	2,846,289		Multnomah	660,486
	Riverside	1,545,387		Tillamook	24,262
	Sacramento	1,223,499	WA	Clallam	64,525
	San Benito	53,234		Clark	345,238
	San Bernardino	1,709,434		Cowlitz	92,948
	San Diego	2,813,833		Grays Harbor	67,194
	San Francisco	776,733		Island	71,558
	San Joaquin	563,598		Jefferson	25,953
	San Luis Obispo	246,681		King	1,737,034
	San Mateo	707,161		Kitsap	231,969
	Santa Barbara	399,347		Lewis	68,600
	Santa Clara	1,682,585		Mason	49,405
	Santa Cruz	255,602		Pacific	20,984
	Siskiyou	44,301		Pierce	700,820
	Solano	394,542		San Juan	14,077
	Sonoma	458,614		Skagit	102,979
	Sutter	78,930		Skamania	9,872
	Trinity	13,022		Snohomish	606,024
	Ventura	753,197		Thurston	207,355
	Yolo	168,660		Wahkiakum	3,824
OR	Benton	78,153		Whatcom	166,814

Source: U.S. Census Bureau, 2000.

* The Office of Ocean Resources, Conservation and Assessment (ORCA), National Ocean Service (NOS), National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce classifies counties as coastal "because they meet one of the following criteria: (1) at least 15 percent of their total land area is located within the nation's coastal watersheds (as defined by ORCA's Coastal Assessment Framework [*http://spo.nos.noaa.gov/projects/caf/caf.html*, page not dated], or (2) the county accounts for at least 15 percent of the land area of a coastal cataloging unit (a U.S. Geological Survey-defined drainage basin)" (*http://spo.nos.noaa.gov/projects/population/population.html*, page not dated). The U.S. Bureau of the Census also uses ORCA's coastal counties list.

F.6. ALASKA REGION

Table F.6-1
Nonendangered Marine Mammals of the Alaska Region

Group	Scientific Name	Common Name
Cetaceans	*Eschrichtius robustus*	Gray whale
	Balaenoptera acutorostrata	Minke whale
	Orcinus orca	Killer whale
	Ziphius cavirostris	Cuvier's beaked whale
	Mesoplodon stejnegeri	Stejneger's beaked whale
	Phocoenoides dalli	Dall's porpoise
	Delphinapterus leucas	Beluga whale
	Phocoena phocoena	Harbor porpoise
	Lagenorhynchus obliquidens	Pacific white-sided dolphin
Pinnipeds	*Callorhinus ursinus*	Northern fur seal
	Phoca largha	Spotted seal
	Phoca fasciata	Ribbon seal
	Erignathus barbatus	Bearded seal
	Phoca hispida	Ringed seal
	Phoca vitulina	Harbor seal
	Odobenus rosmarus divergens	Pacific walrus

Source: USCG, 2002.

Table F.6-2
Nonendangered Marine and Coastal Birds of the Alaska Region

Group	Family or Scientific Name	Common Name
Seabirds	Diomedeidae	Albatrosses
	Procellariidae	Petrels, shearwaters, fulmars
	Hydrobatidae	Storm petrels
	Phalacrocoracidae	Cormorants
	Stercorariidae	Jaegers
	Laridae	Gulls, terns, kittiwakes
	Alcidae	Auklets, puffins, guillemots, murres, murrelets
	Graviidae	Loons
	Podicipedae	Grebes
Shorebirds	Charadriidae	Plovers
	Scolopacidae	Sandpipers, turnstones, godwits, yellowlegs, whimbrels, dunlins, dowitchers, sanderlings, surfbirds, tattlers, red knots, snipes
	Phalaropodidae	Phalaropes
	Haematopodidae	Oystercatchers
Marsh and wading birds	Gruidae	Cranes
	Ardeidae	Herons
Waterfowl	Anatidae	Eiders, swans, ducks, geese,
Raptors	*Haliaeetus leucocephalus*	Bald eagle
	Falco peregrinus	American peregrine falcon
	Falco peregrinus tundrius	Arctic peregrine falcon

Source: Adapted from MMS, 2001.

Table F.6-3
National Park Units in the Alaska Region

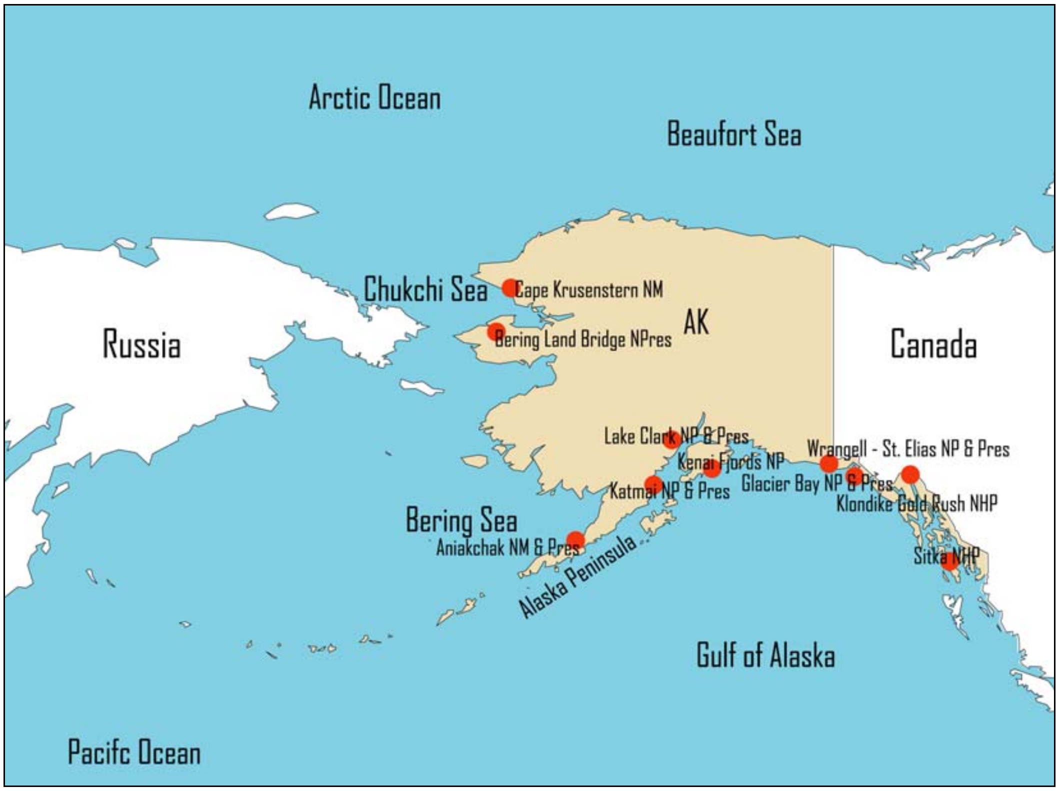
Congress established the National Park Service to ensure protection and interpretation of some of the finest examples of natural, cultural, and recreational resources. The National Park Service sets aside areas of historical and recreational value that are maintained at various stages of development, ranging from a natural pristine environment to recreational facilities and concessions. The development at any given park unit depends on the primary goal for which it was established. Park units set aside to preserve specific environments or historic locations may have localized areas developed to accommodate various uses, such as hunting, fishing, shell fishing, swimming, picnicking, hiking, camping, and boating. These uses must be compatible with the preservation of the environment or the historic location for which the park was established. Two-thirds of the entire National Park System (nearly 55 million acres) lies in AK. There are ten coastal or near-coastal National Park units in the Alaska region.

National Park Unit	Description
Sitka NHP	This 113-acre park is located in a temperate rain forest that occupies a natural harbor on Baranof Island, part of the panhandle of southeastern AK. It is AK's oldest federally designated park, and it commemorates the last major conflict between Europeans and Alaska Natives. The park includes the Russian Bishop's House, one of three surviving examples of Russian colonial architecture in North America.
Klondike Gold Rush NHP	Located in Skagway, AK, this park includes the Skagway Historic District, with 15 restored buildings from the 1897–98 Klondike Gold Rush, the 33-mi Chilkoot Trail, a portion of the Dyea Townsite (at the foot of the Chilkoot Trail), and a small portion of the White Pass Trail.
Glacier Bay NP and Pres	The park is located in the panhandle of southeastern Alaska and covers approximately 3.3 million acres. Over 200 species of fish swim in park waters, including all five species of Pacific salmon. About 220 bird species, or over 25 percent of the total number of species in all of North America, have been recorded here. The park has been recognized as both a World Heritage Site and a Biosphere Reserve.
Wrangell-St. Elias NP and Pres	This 14-million-acre park and preserve, the largest unit in the National Park System, is located in eastern AK where the panhandle of southeastern AK joins the main body of the state. As one of the largest protected ecosystems in North America, it supports populations of at least 32 species of mammals, 127 of birds, 16 of fish, and 1 of amphibian. It has been designated a joint World Heritage Site with Kluane NP Reserve, Alsek-Tatshenshini Provincial Park, and Glacier Bay NP and Pres.
Kenai Fjords NP	Located near the town of Seward in south central AK, this park consists of 607,805 acres. The Harding Icefield covers more than half the park and conceals a mountain range under ice several thousand feet thick. Bald eagles and thousands of seabirds, including puffins, kittiwakes, and murres, seasonally inhabit this area.
Lake Clark NP and Pres	This 4-million-acre park is located about 100 mi southwest of Anchorage, north of Lake Iliamna. It is a significant part of the greater Bristol Bay watershed, which is the world's largest sockeye salmon fishery. This park and preserve contains four of the five biotic communities found in AK: tundra, riparian, coastal and forest.
Katmai NP and Pres	This 3.7-million-acre park is located on the eastern shore of Shelikof Strait, which is about 200 mi southwest of Anchorage. There are at least fourteen active volcanoes in the park, and brown bear and salmon are very active here. It is also the site of the Brooks River National Historic Landmark, which has North America's highest concentration of prehistoric human dwellings.
Aniakchak NM and Pres	Consisting of 603,000 acres on the Alaska Peninsula, west of Kodiak Island, this monument includes the Aniakchak Caldera, which is a 6-mi-wide, 2,000-ft-deep caldera formed by the collapse of a 7,000-ft mountain. It provides prime habitat for land mammals, waterfowl, marine mammals, fish and shellfish, and extensive wild runs of five salmon species of Pacific salmon.
Bering Land Bridge NPres	This preserve is one of the most remote national park areas, sprawling across 2.7 million acres of the Seward Peninsula in northwest AK. Its western boundary lies 42 mi from the Bering Strait and the United States–Russia fishing boundary. It is a remnant of the 1,000-mi land bridge that connected Asia with North America more than 13,000 years ago; the majority of this land bridge now lies beneath the Chukchi and Bering Seas.
Cape Krusenstern NM	This treeless coastal plain dotted with lagoons and backed by limestone hills occupies 659,807 acres in northwest AK. The southern border of the monument is 10 mi northwest of Kotzebue, and the western border is the Chukchi Sea.

Source: For National Park units, ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: NHP, National Historical Park; NM, National Monument; NP, National Park; NPres, National Preserve; Pres, Preserve.

Figure F.6-1
National Park Units in the Alaska Region



Source: ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: NHP, National Historical Park; NM, National Monument; NP, National Park; NPres, National Preserve; Pres, Preserve. Map is not to scale.

Table F.6-4
National Wildlife Refuges in the Alaska Region

The National Wildlife Refuge System is a network of U.S. lands and waters managed specifically for the enhancement of wildlife. National Wildlife Refuges were established and are administered by the USFWS under the Fish and Wildlife Act of 1956 (16 U.S.C. 742a–742j, not including 742 d-l; 70 Stat. 1119) and the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd–668ee). These acts allow the USFWS to acquire and to administer lands for the development, advancement, management, conservation, and protection of fish and wildlife resources. Most refuges are managed for the enhancement of resident and migratory wildlife and are available for public recreational use, such as fishing, wildlife observation, hunting, and boating. There are ten coastal or near-coastal National Wildlife Refuges in the Alaska region.

National Wildlife Refuge	Description
Kenai	This nearly 2-million acre refuge consists of the western slopes of the Kenai Mountains and forested lowlands bordering Cook Inlet and includes all AK habitat types—tundra, mountains, wetlands, and forests. The refuge is host to Dall sheep, mountain goat, caribou, coyote, wolf, grizzly bear, black bear, lynx, wolverine, beaver, small mammals, and birds. Kenai Refuge provides undisturbed spawning for many Cook Inlet salmon.
Kodiak	This refuge consists of 1.65 million acres or about two-thirds of Kodiak Island. In addition, the refuge includes a portion of Afognak Island (50,000 acres) to the north of Kodiak Island. Kodiak Island has an irregular coastline of bays and inlets that up to 2 million seabirds inhabit.

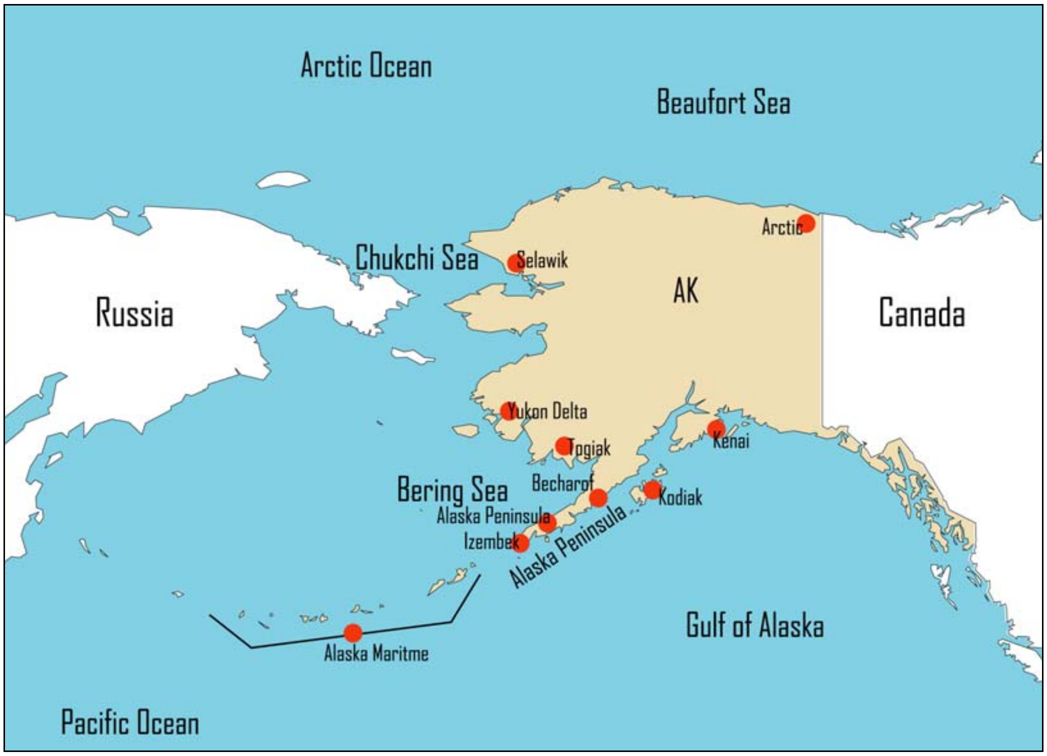
continued

Table F.6-4 (*continued*)
National Wildlife Refuges in the Alaska Region

National Wildlife Refuge	Description
Becharof	Located between Katmai National Park and Preserve and the Alaska Peninsula National Wildlife Refuge, this refuge contains approximately 1.2 million acres. Sea otters, sea lions, harbor seals, and migratory whales inhabit the shoreline and offshore waters. Waterfowl are common in the wetlands and coastal estuaries while nesting eagles, peregrine falcons, and thousands of seabirds inhabit the sea cliffs.
Alaska Peninsula	Located 300 air mi southwest of Anchorage, this refuge encompasses approximately 3.5 million acres of tundra, towering mountains, active volcanoes, and rugged coastlines. Sea lions, harbor seals, sea otters, and migratory whales inhabit the shores and offshore waters. The refuge provides habitat for migratory birds, including ducks, geese, shorebirds, and passerines.
Izembek	This refuge consists of 302,000 acres of land and is located on the Alaska Peninsula north of Unimak Island and south of the Alaska Peninsula National Wildlife Refuge. It protects the watershed of Izembek Lagoon, which contains one of the largest eelgrass beds in the world.
Alaska Maritime	This refuge consists of more than 2,400 islands, headlands, rocks, islets, spires, and reefs of the AK coast. It stretches from Cape Lisburne on the Chukchi Sea to the tip of the Aleutians. About 75 percent of AK marine birds (15 to 30 million birds among 55 species) use this refuge.
Togiak	This refuge is located in southwestern AK on the northern shore of Bristol Bay and encompasses approximately 4.8 million acres. Seals, sea lions, walrus, and seven species of whales are found along the refuge's shorelines.
Yukon Delta	This 19.6-million acres refuge is located in southwestern AK between Norton Sound and Kuskokwim Bay. It contains the deltas of both the Yukon and Kuskokwim Rivers and Nunivak Island. This vast wetland supports one of the largest aggregations of water birds on earth.
Selawik	Located where the Bering Land Bridge once existed, this refuge is composed of estuaries, over 24,000 lakes, river deltas, and tundra slopes, the most prominent feature being the extensive system of tundra wetlands that are nestled between the Waring Mountains and the Selawik Hills.
Arctic	This 19.1-million acre refuge is located in northeastern AK along the Beaufort Sea coast. Wildlife found within the refuge includes more than 160 bird species, 36 kinds of land mammals, 9 marine mammal species, and 36 types of fish.

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Figure F.6-2
National Wildlife Refuges in the Alaska Region



Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Note: Map is not to scale.

Table F.6-5
National Estuarine Research Reserves in the Alaska Region

The National Estuarine Research Reserve Program was established by the Coastal Zone Management Act of 1972 (16 U.S.C. 1451–1464) and is administered by the Sanctuaries and Reserves Division, National Oceanic and Atmospheric Administration. A primary objective of Congress in establishing the estuarine research-reserve program is to provide information to be used by coastal managers and fishing industries by providing research information that will help assure the continued productivity of estuarine ecosystems. The Coastal Zone Management Act of 1972, as amended, established the National Estuarine Sanctuary Program to provide financial assistance awards on a matching basis to states to acquire, develop, and operate estuarine areas as natural field laboratories. The purpose of the program is to provide long-term protection to vital habitats for estuarine-dependent life, thus preserving relatively unaltered estuarine areas for baseline scientific research and educational programs. There is one coastal or near-coastal National Estuarine Research Reserve in the Alaska region.

National Estuarine Research Reserve	Description
Kachemak Bay	Located approximately 150 mi south of Anchorage, AK, on the western coast of the Kenai Peninsula, this reserve covers 365,000 acres and is the largest National Estuarine Research Reserve in the system. It is also one of the most diverse, productive, and intensively used estuaries in AK. The reserve contains extensive tidal mudflats, subtidal habitat, upland forests, the Kenai Mountains, and nearby glaciers.

Source: Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://nerrs.noaa.gov/Reserves.html,* revised September 25, 2003).

Figure F.6-3
National Estuarine Research Reserves in the Alaska Region

Source: Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://nerrs.noaa.gov/Reserves.html,* revised September 25, 2003).

Note: Map is not to scale.

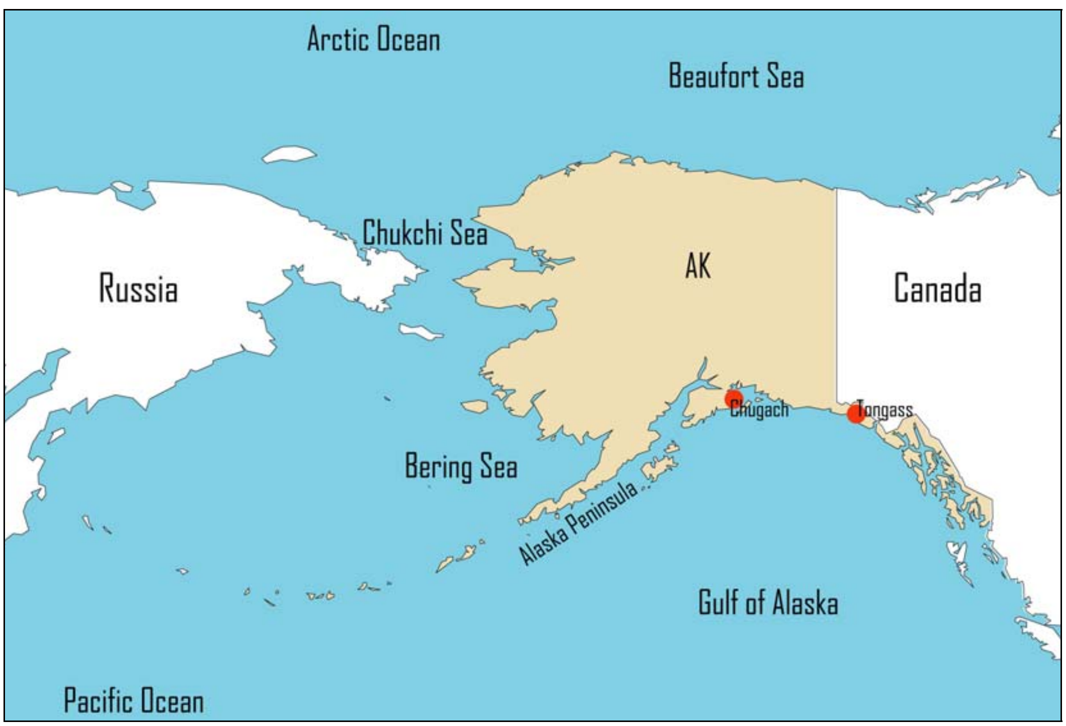
Table F.6-6
National Forests in the Alaska Region

Congress established the U.S. Forest Service in 1905 to provide quality water and timber for the nation's benefit. Congress directed the Forest Service to manage National Forests for multiple uses and benefits and for the sustained yield of renewable resources such as water, forage, wildlife, wood, and recreation. "Multiple use" means managing resources under the best combination of uses to benefit the American people, while ensuring the productivity of the land and protecting the quality of the environment. National Forests are America's great outdoors, and they provide opportunities for recreation in open spaces and natural environments. There are two coastal or near-coastal National Forests in the Alaska region.

National Forest	Description
Tongass	Located in southeast AK, this forest stretches northward from Dixon Entrance south of Ketchikan to the far edge of the Malaspina Glacier near Yakutat Bay. It is the largest National Forest in the United States, encompassing 17 million acres and stretching over 11,000 mi of coastline, about half that of the entire United States. The forest is in a temperate rain forest zone, receiving more than 80 in of rain per year, and includes glaciers, mountains, waterways, and thousands of islands.
Chugach	Covering approximately 5.9 million acres, this forest extends south and east of Anchorage along the south central AK coast and skirts Prince William Sound. It is the second largest National Forests in the United States, covering approximately 5.9 million acres and stretching over 200 miles from border to border.

Source: Forest Service, U.S. Department of Agriculture (*http://www.fs.fed.us/recreation/map/finder.shtml*, last modified June 10, 2002).

Figure F.6-4
National Forests in the Alaska Region



Source: Forest Service, U.S. Department of Agriculture (http://www.fs.fed.us/recreation/map/finder.shtml, last modified June 10, 2002).

Note: Map is not to scale.

Table F.6-7
Coastal Population of the Alaska Region

Coastal Borough/Census Area/Municipality	Population
Aleutians East Borough	2,697
Aleutians West Census Area	5,465
Anchorage Municipality	260,283
Bethel Census Area	16,006
Bristol Bay Borough	1,258
Dillingham Census Area	4,922
Haines Borough	2,392
Juneau City and Borough	30,711
Kenai Peninsula Borough	49,691
Ketchikan Gateway Borough	14,070
Kodiak Island Borough	13,913
Lake and Peninsula Borough	1,823
Matanuska-Susitna Borough	59,322
Nome Census Area	9,196
North Slope Borough	7,385
Northwest Arctic Borough	7,208
Prince of Wales-Outer Ketchikan Census Area	6,146
Sitka City and Borough	8,835
Skagway-Hoonah-Angoon Census Area	3,436
Valdez-Cordova Census Area	10,195
Wade Hampton Census Area	7,028
Wrangell-Petersburg Census Area	6,684
Yakutat City and Borough	808

Source: NOAA, 2002; U.S. Census Bureau, 2000.

F.7. OCEANIA REGION

Table F.7-1
Nonendangered Marine Mammals of the Oceania Region

Group	Scientific Name	Common Name
Cetaceans	*Feresa attenuata*	Pygmy killer whale
	Pseudorca crassidens	False killer whale
	Orcinus orca	Killer whale
	Kogia simus	Dwarf sperm whale
	Kogia breviceps	Pygmy sperm whale
	Globicephala macrorhynchus	Short-finned pilot whale
	Balaenoptera acutorostrata	Minke whale
	Balaenoptera edeni	Bryde's whale
	Berardius bairdii	Baird's beaked whale
	Mesoplodon densirostris	Blainsville's whale
	Ziphius cavirostris	Cuvier's beaked whale
	Peponocephala electra	Melon-headed whale
	Steno bredanensis	Rough-toothed dolphin
	Stenella attenuata	Spotted dolphin
	Stenella longirostris	Spinner dolphin
	Tursiops truncatus	Bottlenose dolphin

Source: USCG, 2002.

Table F.7-2
Nonendangered Marine and Coastal Birds of the Oceania Region

Group	Family or Scientific Name	Common Name
Seabirds	Diomedeidae	Albatrosses
	Procellariidae	Petrels, shearwaters
	Hydrobatidae	Storm petrels
	Sulidae	Gannets, boobies
	Phaethontidae	Tropic birds
	Fregatidae	Frigate birds
	Phalacrocorcidae	Cormorants
	Scolopacidae	Phalaropes
	Laridae	Gulls, terns, noddies
	Podicipedae	Grebes
Shorebirds	Recuvirostridae	Stilts
	Scolopacidae	Sandpipers, snipes, phalaropes
	Charadriidae	Plovers
Marsh and wading birds	Ardeidae	Herons, egrets
	Threskiornithidae	Ibises
	Gruidae	Cranes
	Rallidae	Rails, moorhens, gallinules, coots
Waterfowl	Anatidae	Swans, ducks, geese

Source: Migratory Birds and Habitat Programs, U.S. Fish and Wildlife Service, U.S. Department of the Interior (*http://migratorybirds.pacific.fws.gov/pacific_islands_conservation_programs.htm*).

Table F.7-3
National Marine Sanctuaries and National Park Units in the Oceania Region

The National Marine Sanctuaries Program administered by NOAA was created in Title III of the Marine Protection, Research and Sanctuary Act of 1972 (33 U.S.C. 1401–1445, 16 U.S.C. 1431–1445). National Marine Sanctuaries are created to protect areas that have exhibited high levels of biodiversity, ecological integrity, and/or cultural legacy. They are the breeding and feeding grounds of whales, sea lions, sharks, and sea turtles, and contain unique marine habitats. There are two coastal or near-coastal National Marine Sanctuaries in the Oceania region.

National Marine Sanctuary	Description
Hawaiian Islands Humpback Whale	The total area of this sanctuary is about 1,400 mi^2, encompassing the waters around the main Hawaiian Islands. These waters constitute one of the world's most important North Pacific humpback whale habitats and the only place in the United States where humpbacks reproduce. Approximately two-thirds of the entire North Pacific humpback whale population migrates to these waters to breed, calve, and nurse their young.
Fagatele Bay	The smallest and most remote of all National Marine Sanctuaries, this sanctuary encompasses only 163 acres and is located on Tutuila, American Samoa, with its borders extending from the southernmost point of the island to the island's southwestern shore. It is the only true tropical coral reef in the National Marine Sanctuaries Program.
Hawaii Volcanoes NP	Located near Hilo, Hawaii, this park encompasses nearly 218,000 acres, including the earth's most massive volcano, Mauna Loa, and most active volcano, Kilauea. Over half of the park is a designated Wilderness Area, and it has been recognized as an International Biosphere Reserve and a World Heritage Site.

continued

Table F.7-3 (*continued*)
National Marine Sanctuaries and National Park Units in the Oceania Region

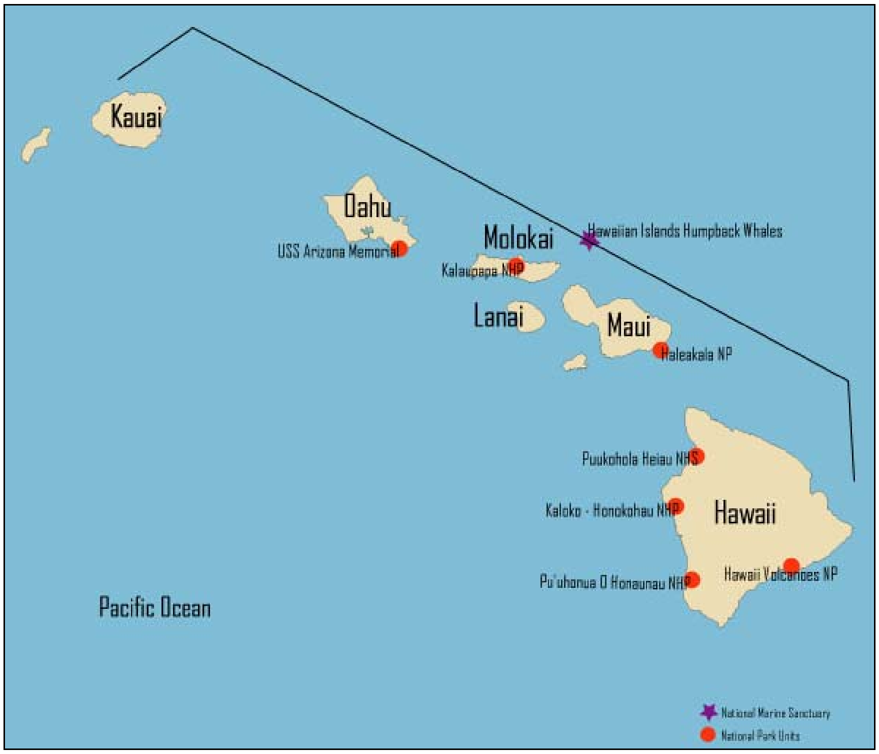
Congress established the National Park Service to ensure protection and interpretation of some of the finest examples of natural, cultural, and recreational resources. The National Parks Service sets aside areas of historical and recreational value that are maintained at various stages of development, ranging from a natural pristine environment to recreational facilities and concessions. The development at any given park unit depends on the primary goal for which it was established. Park units set aside to preserve specific environments or historic locations may have localized areas developed to accommodate various uses, such as hunting, fishing, shell fishing, swimming, picnicking, hiking, camping, and boating. These uses must be compatible with the preservation of the environment or the historic location for which the park was established. State and territorial parks provide for the same protection and enjoyment of similar resources throughout the Oceania region. There are ten coastal or near-coastal National Park units in the Oceania region.

National Park Unit	Description
Pu'uhonua O Honaunau NHP	Located in Honaunau, Hawaii, this 182-acre park preserves a complex of archaeological sites, including the site where Hawaiians who broke an ancient law against the gods could avoid certain death by fleeing to this place of refuge or "pu'uhonua."
Kaloko-Honokohau NHP	Located in Kailua-Kona, Hawaii, this 1,160-acre park preserves, protects, and interprets traditional native Hawaiian activities and culture. It is the site of an ancient Hawaiian settlement that encompasses portions of four different traditional sea-to-mountain land divisions.
Puukohola Heiau NHS	The founding of the Hawaiian kingdom can be directly associated with one structure in the Hawaiian Islands: Pu'ukohola Heiau, a temple constructed by Kamehameha I to incur the favor of the war god Juka'ilimoku. Located in Kawaihea, Hawaii, this 85-acre site includes the temple plus property of John Young, who fought for Kamehameha I.
Haleakala NP	Located near Kula, Maui, this park preserves the volcanic landscape of the upper slopes of Haleakala and protects the ecosystems of Kipahulu Valley, the scenic pools along Oheo Gulch, and many rare and endangered species. Of its 30,183 acres, 19,270 are Wilderness Areas. It was designated an International Biosphere Reserve in 1980.
Kalaupapa NHP	Located on the north shore of Molokai, this park contains the historic Hansen's disease settlements of Kalaupapa and Kalawao. Kaulaupapa, on the leeward side of the Kalaupapa Peninsula, is still home for many surviving Hansen's disease patients.
U.S.S. ARIZONA Memorial	Located in Honolulu, Oahu, the 184-ft memorial straddles the sunken hull of the battleship *U.S.S. ARIZONA* and commemorates the December 7, 1941, Japanese attack on Pearl Harbor. It has also attracted the attention of scientists in recent years as they have begun exploration to determine how long the *U.S.S. ARIZONA* will safely hold the million gallons of oil that it still contains.
American Memorial Park	Located in Saipan, CNMI, this park honors the American and Marianas people who gave their lives during the Marianas Campaign of World War II. Over 5,000 names are inscribed on a memorial, which rests at the park's Court of Honor and Flag Circle, where the U.S. flag flies 24 hours a day. Within the park's 133-acre boundaries is a 30-acre wetland and mangrove forest.
War in the Pacific NHP	Composed of seven units on Guam, two of which are located in the coastal zone (Asan and Agat), this 2,037-acre park is the only site in the National Park System that honors all people from all nations who participated in the Pacific Theater of World War II.
NP of American Samoa	This 9,000-acre park is located on three separate islands of American Samoa (Tutuila, Ofu, and Ta'u), with approximately one-quarter of the total park area being offshore waters. The park's two rain forest preserves and coral reef are home to unique tropical animals such as the flying fox, Pacific boa, tortoises, and an array of birds and fish.

Source: For National Marine Sanctuaries, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://www.sanctuaries.nos.noaa.gov/oms/oms.html,* revised January 14, 2003). For National Park units, ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: CNMI, Commonwealth of Northern Mariana Islands; NHP, National Historical Park; NHS, National Historic Site; NP, National Park.

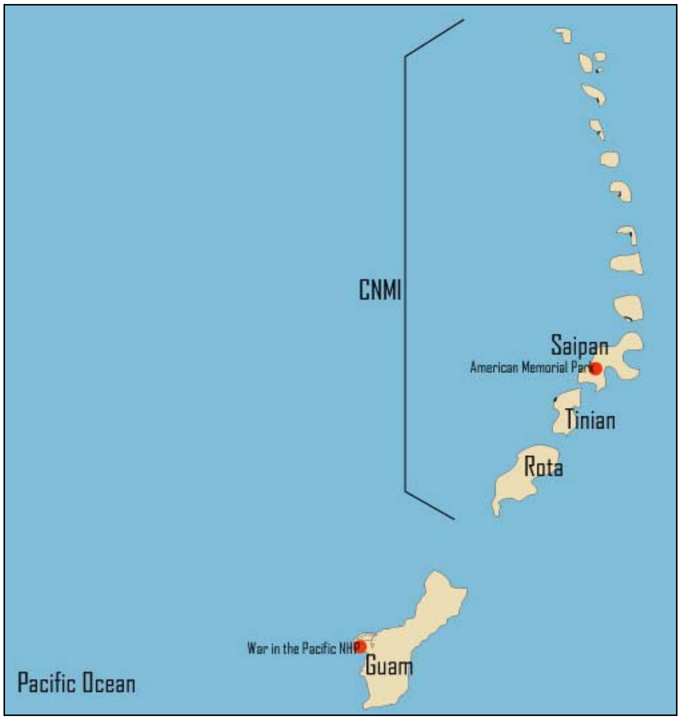
Figure F.7-1
National Marine Sanctuaries and National Park Units in the Oceania Region—Hawaiian Islands



Source: For National Marine Sanctuaries, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://www.sanctuaries.nos.noaa.gov/oms/oms.html,* revised January 14, 2003). For National Park units, ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: NHP, National Historical Park; NHS, National Historic Site; NP, National Park. Map is not to scale.

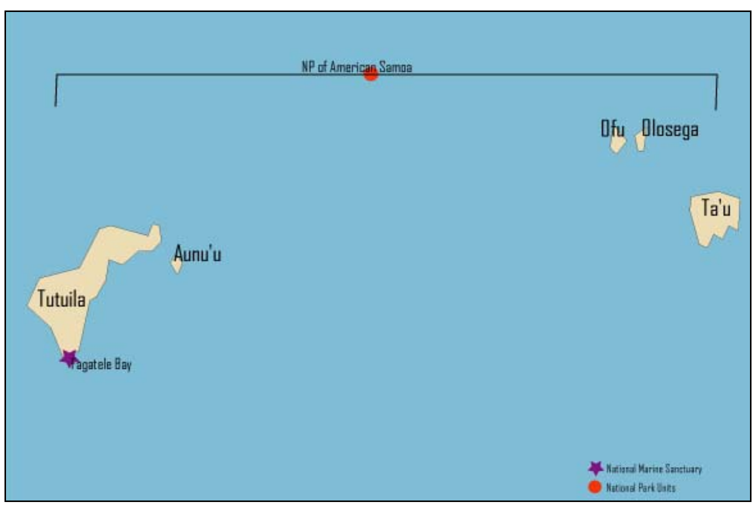
Figure F.7-2
National Park Units in the Oceania Region—
Guam and Commonwealth of Northern Mariana Islands



Source: ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: CNMI, Commonwealth of Northern Mariana Islands; NHP, National Historical Park; NHS, National Historic Site; NP, National Park. Map is not to scale.

Figure F.7-3
National Marine Sanctuaries and National Park Units in the Oceania Region—American Samoa



Source: For National Marine Sanctuaries, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (*http://www.sanctuaries.nos.noaa.gov/oms/oms.html,* revised January 14, 2003). For National Park units, ParkNet, National Park Service, U.S. Department of the Interior (*http://www.nps.gov/*, updated December 3, 2003).

Note: NHP, National Historical Park; NHS, National Historic Site; NP, National Park. Map is not to scale.

Table F.7-4
National Wildlife Refuges in the Oceania Region

The National Wildlife Refuge System is a network of U.S. lands and waters managed specifically for the enhancement of wildlife. National Wildlife Refuges were established and are administered by the USFWS under the Fish and Wildlife Act of 1956 (16 U.S.C. 742a–742j, not including 742 d-l; 70 Stat. 1119) and the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd–668ee). These acts allow the USFWS to acquire and to administer lands for the development, advancement, management, conservation, and protection of fish and wildlife resources. Most refuges are managed for the enhancement of resident and migratory wildlife and are available for public recreational use, such as fishing, wildlife observation, hunting, and boating. There are eighteen coastal or near-coastal National Wildlife Refuges in the Oceania region.

National Wildlife Refuge	Description
Big Island Complex • Hakalau Forest • Kona Forest	This complex consists of the 33,000-acre Hakalau Forest, which is located the eastern slope of Mauna Loa, and the 5,300-acre Kona Forest, which is located on the western slope of Mauna Loa. The complex was established specifically for the conservation of endangered birds including the akiapola'au, the Hawaiian akepa, creeper, hawk, o'u, 'elepaio, and oma'o, as well as the Hawaiian hoary bat.
Maui Complex • Kakahaia • Kealia Pond	This complex includes Kakahaia on Molokai and Kealia Pond on the south coast of Maui. Kakahaia contains a 15-acre pond and a manmade 7-acre impoundment and provides habitat for the endangered Hawaiian coot and stilt. Kealia Pond consists of 700 acres of some of the last remaining natural wetland habitat in HI and provides habitats for the endangered Hawaiian stilt, coot, and wintering migratory waterfowl and shorebirds.
Oahu Complex • James Campbell • Pearl Harbor • Oahu Forest	Located at the northernmost tip of Oahu, the 162-acre James Campbell protects the endangered Hawaiian moorhen, coot, stilt, and koloa (Hawaiian duck) and serves as a strategic landfall for migratory birds coming from as far AK and Siberia. The 37-acre Honouliuli Unit which borders West Loch and the 25-acre Waiawa Unit bordering Middle Loch, Pearl Harbor protects some of the last remaining wetlands on Oahu. Oahu Forest is located on the upper slopes of the Ko'olau Mountains and is home to the endangered Oahu tree snails, plants species, and many native birds.
Kauai Complex • Hanalei • Kilauea Point • Huleia	The 917-acre Hanalei, located on the northern coast of Kauai, consists of river bottom land, taro farms, and wooded slopes and protects the endangered koloa (Hawaiian duck) and the Hawaiian gallinule, coot, and stilt. Located on the northernmost tip of the island, Kilauea Point consists of 200 acres of cliffs and headlands and is home to red-footed boobies, shearwaters, great frigatebirds, brown boobies, red-tailed and white-tailed tropicbirds, and Laysan albatrosses. Located on the southeast side of Kauai, the 241-acre Huleia provides habitat for four species of endangered waterbirds and migratory waterfowl and shorebirds.
Midway Atoll	Measuring approximately 5 mi in diameter and consisting of three sand islands surrounded by a coral reef, the Midway Atoll is a nesting ground for millions of seabirds, including the Laysan albatross and the black-footed albatross. The refuge also serves as a major breeding area for the endangered Hawaiian monk seal, the threatened green sea turtle, and the spinner dolphin.
Hawaiian Islands	Consisting of a chain of eight islands, reefs, and atolls extending about 800 mi northwest from the main Hawaiian Islands, this refuge provides breeding grounds for four endangered endemic bird species—Laysan duck, Laysan finch, Nihoa finch, and Nihoa millerbird. The refuge also supports the entire population of endangered Hawaiian monk seal and provides nesting beaches for virtually the entire HI population of threatened green sea turtles.
Guam	Located at Ritidian Point (the northernmost point of Guam), this 22,500-acre refuge has 401 acres of coral reef and deepwater marine habitats backed by 321 acres of high limestone cliffs, native limestone forests, and beach. It provides habitats for the last remaining colonies on Guam of the endangered island swiftlet, Mariana fruit bat, Mariana crow, and common Mariana moorhen.

continued

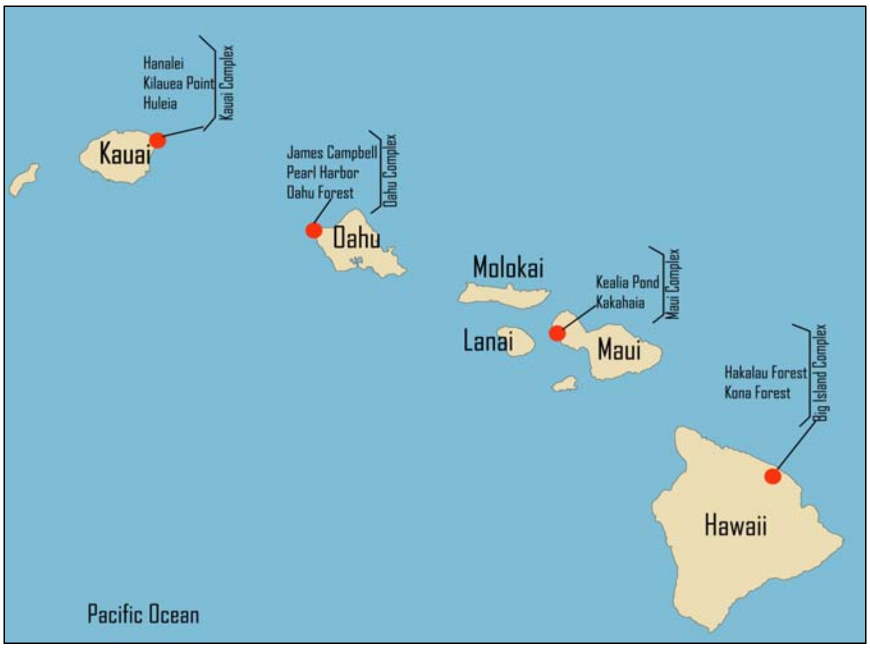
Table F.7-4 (*continued*)
National Wildlife Refuges in the Oceania Region

National Wildlife Refuge	Description
Howland Island Baker Island Jarvis Island Rose Atoll Johnston Atoll	These refuges consist of low coral atolls vegetated only by grasses, prostrate vines, and low-growing shrubs because of scant rainfall, constant wind, and burning sun. Only Johnston Atoll is inhabited. The refuges are important seabird nesting rookeries for sooty terns, gray-backed terns, shearwaters, red-footed boobies, brown boobies, masked boobies, lesser and great frigatebirds, red-tailed tropicbirds, and brown noddies.

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Note: Howland Island, Baker Island, Jarvis Island, Rose Atoll, and Johnston Island are not depicted in a figure because of their distance from each other and from any of the main islands discussed in the Oceania region.

Figure F.7-4
National Wildlife Refuges in the Oceania Region—Hawaiian Islands



Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Note: Map is not to scale.

Figure F.7-5
National Wildlife Refuges in the Oceania Region—Northern Hawaiian Islands

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Note: Map is not to scale.

Figure F.7-6
National Wildlife Refuges in the Oceania Region—
Guam and Commonwealth of Northern Mariana Islands

Source: Office Directory, U.S. Fish & Wildlife Service, U.S. Department of the Interior (*http://offices.fws.gov/*, page not dated); Recreation.gov database, U.S. Department of the Interior (*http://www.recreation.gov/index.cfm,* page revised November 21, 2003).

Note: CNMI, Commonwealth of Northern Mariana Islands. Map is not to scale.

Table F.7-5
Coral Reef Ecosystem Reserves and Special Management Areas in the Oceania Region

Executive Order 13178 created the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. As part of the establishment of the reserve, Executive Order 13178 contains conservation measures that restrict some activities throughout the reserve and establishes Reserve Preservation Areas around certain islands, atolls, and banks where all consumptive or extractive uses are prohibited. The coral banks and shoals of the reserve are Nihoa Island, Necker Island, French Frigate Shoals, Gardner Pinnacles, Maro Reef, Laysan Island, Lisianski Island, Pearl and Hermes Atoll, Kure Atoll, Bank west of the French Frigate Shoals, and the Southeast Brooks Bank.

Coral Reef Ecosystem Reserve	Description
Northwestern Hawaiian Islands	This reserve encompasses approximately 99,500 nm² of the marine waters and submerged lands of the Northwestern Hawaiian Islands extending approximately 1,200 nm long and 100 nm wide. This stretch of coral islands, atolls, pinnacles, seamounts, banks, and shoals west-northwest of Kauai, HI, is unquestionably some of the healthiest and most extensive corals reefs in the world. Approximately 70 percent of U.S. coral reefs are located here. This vast area supports a more than 7,000 marine species, of which approximately half are unique to the Hawaiian Islands chain.

Special Management Areas are unique to American Samoa and are designated under the Administrative Code for the American Samoa Coastal Management Act of 1990, which defines these areas as "possessing unique and irreplaceable habitat, products or materials, offers beneficial functions and/or affects the cultural values or quality of life significant to the general population of the territory and fa'a (Samoan 'way' or culture)." Management objectives are established for coral reefs within the management area that include protecting subsistence activities, preventing adverse impacts to reefs and corals, and avoiding discharges of petroleum products, siltation, and the destruction of productive habitat. There are three Special Management Areas in the Oceania region.

Special Management Area	Description
Pago Pago Harbor	This area is delineated by a line drawn from Goat Island Point to the jetty at Leloaloa and includes all land and water resources on the inner harbor side of the American Samoa Highway 001 paralleling the shore around the Pago Pago Harbor.
Leone Bay (Leone Pala)	Located on the southwest coastal area of American Samoa's island of Tutuila, it consists of 8.4 hector acres of wetlands and 3.6 hector acres of mangroves. It is also part of the Protected Areas Programme sponsored by the United Nations Environment Programme.
Pala Logoon (Nu'uuli Pala)	Located on the south coast of American Samoa's island of Tutuila this coastal mangrove swamp covers 49.7 hector acres.

Source: Scott, 1993.

Table F.7-6
Coastal Population of the Oceania Region

State/U.S.-Affiliated Island	County/District	Population
Hawaii (county)	Hawaii	148,677
	Honolulu	876,156
	Kalawao	147
	Kauai	58,463
	Maui	128,094
Guam (district)	Agana Heights	3,940
	Agat	5,656
	Asan	2,090
	Barrigada	8,652
	Chalan Pago-Ordot	5,923
	Dededo	42,980
	Hagatn'a	1,100

continued

Table F.7-6 (*continued*)
Coastal Population of the Oceania Region

State/U.S.-Affiliated Island	County/District	Population
Guam (district) (*con't*)	Inarajan	3,052
	Mangilao	13,313
	Merizo	2,163
	Mongmong-Toto-Maite	5,845
	Piti	1,666
	Santa Rita	7,500
	Sinajana	2,853
	Talofofo	3,215
	Tamuning	18,012
	Umatac	887
	Yigo	19,474
	Yona	6,484
CNMI (municipality district)	Northern Islands1	6
	Rota1	475
	Rota2	113
	Rota3	131
	Rota4	2,564
	Saipan1	1,620
	Saipan2	957
	Saipan3	1,049
	Saipan4	639
	Saipan5	2,083
	Saipan6	12,887
	Saipan7	3,745
	Saipan8	6,720
	Saipan9	1,848
	Saipan10	15,845
	Saipan11	14,999
	Tinian1	2,477
	Tinian2	1,063
American Samoa (county)	Swains Island	37
	Ituau	4,312
	Ma'oputasi	11,695
	Sa'ole	1,768
	Sua	3,417
	Vaifanua	2,249
	Faleaso	135
	Fitiuta	358
	Ofu	289
	Olosega	216
	Ta'u	380
	Lealataua	5,684
	Leasina	1,739
	Tualatai	2,987
	Tualauta	22,025

Source: U.S. Census Bureau, 2000.

Note: CNMI, Commonwealth of Northern Mariana Islands.

APPENDIX G
THE ENVIRONMENTAL EFFECTS OF DISPERSANTS WITHOUT OIL

During dispersant operations a portion of the dispersant applied to an oil slick may miss the oil and enter the water column directly, particularly if dispersant droplets are large and slick thickness and distribution varies. Dispersant may also partition from the oil droplets in the water. This effect has been demonstrated by laboratory toxicity experiments with Corexit® 9527 and mineral oil, and may be a common phenomenon (NRC, 1989). Dispersant droplets may also directly affect organisms on the water surface. The intent is, or course, to minimize such exposures during operations but they may still occur and need to be considered.

All dispersant formulations include surface-active agents (surfactants) as well as solvents. The detailed composition of dispersants is proprietary, and the actual compositions of specific dispersant products vary significantly. However, based on a review of patent literature, the surfactants used in modern dispersants are generally blends of nonionic and anionic types. The nonionic types include sorbitan esters of fatty acids, polyalkoxylated sorbitan esters of fatty acids, polyalkoxylated fatty alcohols, polyethylene glycol esters of oleic acid, and tall oil esters. Anionic type surfactants include salts of dialkyl sulfosuccinates and of alkyl benzene sulfonic acid. Typical examples of surfactants used are: sorbitan monolaurate, ethoxylated sorbitan trioleate, ethylene/propylene oxide condensates, ethoxylated tridecylphosphate, sodium dioctyl sulfosuccinate, sodium lauryl sulfate, and isopropylamine dodecyl benzene sulfonate (Fiocco and Lewis, 1999).

Solvents in a dispersant must solubilize the blend of surfactant components and penetrate into the oil when applied, assisting in the diffusion of surfactants through the oil slick to the oil-water interface. Low-toxicity solvents used in modern dispersants include oxygenated compounds such as glycols and glycol ethers and petroleum-derived nonaromatic hydrocarbons. Specific examples include ethylene glycol monobutyl ether, dipropylene glycol monomethyl ether, de-aromatized kerosene, and isoparaffinic solvents, some of which are also used in cosmetics and household cleaners. Components such as alcohols and water are sometimes used as co-solvents or co-surfactants to help solubilize the surfactants and modify viscosity (Fiocco and Lewis, 1999).

The chemical cleaners used during the earliest oil spill dispersant applications (e.g., 1967 *TORREY CANYON* spill) were toxic to marine life because they contained solvents composed of aromatic compounds, such as benzene, toluene, xylene, and naphthalenes. None of these components are used in modern dispersants and modern dispersants are much less toxic than the oils they are used to disperse. Dispersants do have the potential to increase the dissolution rate of the toxic low molecular weight aromatic components of the crude oil into the water column (Fingas et al., 1991). In practice, however, most or all of these components will have already evaporated during the few hours prior to the application of dispersant. Thus, the increase in dissolution of these components because of dispersant use is likely to be very limited (Fiocco and Lewis, 1999; French McCay, 2001, 2002). The modeling analysis in Parts A through F of the technical report (French McCay et al., 2004) supports this conclusion.

Only chemical dispersants that are listed on the current U.S. Environmental Protection Agency's National Oil and Hazardous Substances Pollution Contingency Plan (USEPA's NCP) Product Schedule may be used to treat oil spills in U.S. waters. Manufacturers who want to list their chemical dispersants on the NCP Product Schedule must complete specific tests demonstrating effectiveness of at least 45 percent, aquatic toxicity, and identify ingredients. The results of these tests are sent to the USEPA for evaluation (FDEP, 2001). The August 2001 edition of the NCP Product Schedule includes only seven dispersants from five manufacturers. Only one of these dispersants has hydrocarbon-based solvents (USEPA, 2001).

The primary risks in the application and use of dispersants (those which do not mix with oil) are to birds, furry mammals, water-column organisms, and people. In birds and fur-bearing marine mammals, direct contact with dispersants causes fouling of plumage or fur. Dispersants remove the natural oils of feathers and furs. This destroys the insulating and water repelling properties of the plumage and fur, allowing water to penetrate to the body surface, resulting in hypothermia and loss of buoyancy. Direct contact can also cause irritation to eyes and skin. While these potential impacts are real, they are relatively easy to minimize or eliminate. The presence of sensitive animals is routinely checked before dispersant application. Given reasonable care, areas not in the immediate vicinity of the slick should not be at risk. Animals located in or very close to the slick are at significantly more risk from the oil than from misapplied dispersant.

The use of dispersants also raises the risk to human health. Direct contact between skin and porous membranes may cause irritation or mild toxic effects. Low concentrations, such as those usually used in dispersant application and the concentration found in the water after application, are generally not considered a risk to human health. Risks to personnel who make and load the product are covered in the specific product Material Safety Data Sheet (MSDS), which is available from the manufacturer. Generally, these risks include inhalation hazards, dermal and internal tissue toxicity risks, and general absorption risks through mucous membranes. While workers could experience some risk of exposure to high concentrations when moving or loading concentrated dispersant, oil spill responders or members of the monitoring team will require no special protection equipment or precautions beyond those normally used in spill response operations. Protective measures adequate for minimizing oil exposure are sufficient to minimize exposure to dispersants.

Some water-column toxic effects to marine organisms from dispersants may occur, if dispersant lands directly on the water. For some species, larvae or eggs (which are the most sensitive stages) may concentrate near the surface, and therefore would be at risk. However, such effects would be minor and short-lived due to dilution of the dispersant and recruitment of organisms from unaffected areas (NRC, 1989). These potential impacts are discussed in more detail below, based on consideration of exposures that might occur at an actual spill event.

The potential for exposure begins with the application rate; too much dispersant places excess chemicals into the water column, with no additional benefit in treating the surface slicks; too little, and the application may not be effective, as the interfacial tension and the oil-water interface may not be sufficiently reduced to disperse the oil droplets. As of 1997, the recommended chemical dispersant application is typically reported as 1 to 20 dispersant-to-oil ratio based on several laboratory studies In the field, higher dispersant-to-oil ratios may be used (reaching the NCP guidelines of dispersant-to-oil ratios of 1 to 10) (Scholz et al., 1999).

Dispersant use data from more recent spills show that the dispersant-to-oil ratio has been greatly reduced with new chemical dispersant formulations. During the *SEA EMPRESS* spill in 1996, the dispersant-to-oil ratio was as little as 1 to 65, and during the *CAPTAIN* spill in Scotland, the ratio was on average 1 to 80.

Dispersant application rates are dependent upon the oil type, the extent of weathering the oil has already undergone, the dispersant used, and the weather/wave conditions at the application site. Lightweight, low-viscosity oils or rough sea conditions would require less dispersant (1 to 50, 1 to 100, or even less) to break up a slick. On the other end of the spectrum, high viscosity oils, oils nearing their pour point, or seas under relatively calm conditions may not disperse even when much higher treatment rates (such as 1 to 10 or more) are used (Scholz et al., 1999).

For the purposes of discussion, we will examine the potential for exposure to dispersant only using the most common planning factor, a dispersant-to-oil ratio of 1:20, based on an assumed slick thickness of 0.1 mm. If this information were used to develop an application rate, then the aircraft (or vessel) would attempt to deliver approximately 5 gal per acre. Based on this rate the initial concentration in the water column, if mixing occurs to a depth of 1 m, would be 5 ppm. If the immediate mixing depth is 3 m, then the initial concentration would be approximately 1 ppm. This assumes no lateral mixing, which would immediately begin to dilute the concentrations to even lower levels. Based on reasonable rates of turbulent mixing in the open ocean these concentrations would be maintained for only a few minutes, at most (Lewis and Aurand, 1997). This is, in fact, the basis for the conclusion that "even initial concentrations in the water column are below most, but not all, estimated lethal and sublethal concentrations" (NRC, 1989, p. 123). These concentrations were based on constant exposure tests; when more-recent, spiked-exposure tests are used, species sensitivities tend to be even lower.

George-Ares and Clark (2000) reviewed the toxicity data for the two commonly stockpiled dispersants in the United States (Corexit® 9500 and 9527). Their summary data included both continuous exposure tests, for periods of from 24 to 96 hours, as well as spiked (declining) exposures with a half-life of roughly 2.5 hours, still much longer than likely in open marine environments. No reported continuous exposure EC_{50} or LC_{50} spiked effect concentration was less than approximately 4 ppm. Their summary confirms that few, if any, species would be directly affected by anticipated concentrations, and that any such affects would be restricted to very small water volumes where the application initially occurred.

Since the intent is always to avoid such exposures by appropriately targeting the oil slick, the relative risk from dispersant alone is minimal in comparison to the risk from dispersed oil. Consequently, subsequent discussions focus on dispersed oil only.

This page intentionally left blank

Risk Matrix and Definition of Levels of Concern

% of Resource Potentially Affected	Time to Recovery: > 7 years (SLOW) (1)	3–7 years (2)	1–3 years (3)	< 1 year (RAPID) (4)
> 20 % (large) (A)	1A	2A	3A	4A
10–20% (B)	1B	2B	3B	4B
5–10% (C)	1C	2C	3C	4C
1–5% (D)	1D	2D	3D	4D
0–1% (small) (E)	1E	2E	3E	4E

Source: Adapted from Part A of the technical report (French McCay et al., 2004).

Red represents a high level of concern.

Yellow represents a medium level of concern.

Green represents a low level of concern.