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Environment, Safety and Health
Office of Environmental Audit**

**Environmental Survey
Preliminary Report**

**Strategic Petroleum Reserve
Texas and Louisiana Gulf Coast**

January 1989

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PREFACE
TO
THE DEPARTMENT OF ENERGY
STRATEGIC PETROLEUM RESERVE
ENVIRONMENTAL SURVEY PRELIMINARY REPORT

This report contains the preliminary findings based on the first phase of the Environmental Survey at the Department of Energy (DOE) Strategic Petroleum Reserve (SPR), located in Texas and Louisiana. The Survey is being conducted by DOE's Office of Environment, Safety and Health.

The SPR Survey is a portion of the larger, comprehensive DOE Environmental Survey encompassing all major operating facilities of DOE. The DOE Environmental Survey is one of a series of initiatives announced on September 18, 1985, by Secretary of Energy, John S. Herrington, to strengthen the environmental, safety, and health programs and activities within DOE. The purpose of the Environmental Survey is to identify, via a "no-fault" baseline Survey of all the Department's major operating facilities, environmental problems and areas of environmental risk. The identified problem areas will be prioritized on a Department-wide basis in order of importance in 1989.

The findings in this report are subject to modification based on the results from the Sampling and Analysis Phase of the Survey. The findings are also subject to modification based on comments from the Oak Ridge Operations Office and the SPR Project Management Office concerning their technical accuracy. The modified findings will be incorporated into the Environmental Survey Summary Report.

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PRELIMINARY

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PRELIMINARY

EXECUTIVE SUMMARY

Introduction

This report presents the preliminary environmental findings from the first phase of the Environmental Survey of the United States Department of Energy (DOE) Strategic Petroleum Reserve (SPR), located in Louisiana and Texas, and conducted in two segments from November 30 through December 11, 1987, and February 1 through 10, 1988.

The Survey is being conducted by a multidisciplinary team of environmental specialists, led and managed by the Office of Environment, Safety and Health's Office of Environmental Audit. Individual team specialists are outside experts being supplied by a private contractor. The objective of the Survey is to identify environmental problems and areas of environmental risk associated with SPR. The Survey covers all environmental media and all areas of environmental regulation. It is being performed in accordance with the DOE Environmental Survey Manual. This phase of the Survey involved the review of existing site environmental data, observations of the operations carried on at SPR, and interviews with site personnel.

The Survey team has developed a Sampling and Analysis Plan to assist in further assessing specific environmental problems identified during its on-site activities. The Sampling and Analysis Plan will be executed by Idaho National Engineering Laboratory. When completed, the results will be incorporated into the SPR Survey findings for inclusion into the Environmental Survey Summary Report. The Summary Report will reflect the final determinations of the SPR Survey and the other DOE site-specific Surveys.

Site Description

The SPR consists of six underground crude-oil storage facilities in salt domes and a marine terminal located along the Gulf of Mexico between Freeport, Texas, and St. James, Louisiana. The mission of the SPR is to provide for storage of 750 million barrels of crude oil and thereby diminish U.S. vulnerability to the effects of disruptions in petroleum supplies.

Four sites with existing solution-mined caverns in salt domes and a fifth site consisting of an underground room-and-pillar salt mine were acquired by DOE for use as crude-oil storage sites. The sixth and newest storage site is in the construction phase. The storage sites are located at Bryan Mound and Big Hill in Texas, and at Sulphur Mines, West Hackberry, Weeks Island, and

Bayou Choctaw in Louisiana. Additional storage capacity to achieve the 750-million-barrel objective is being developed by SPR through construction of new caverns by solution mining at Big Hill, West Hackberry, and Bayou Choctaw. The marine terminal is located at St. James, Louisiana, on the Mississippi River, and the SPR Project Management Office is located in New Orleans, Louisiana.

The Survey team met with representatives of state and Federal regulatory agencies prior to the on-site Survey. These representatives expressed minimal concern over the actual and potential environmental problems at SPR. Issues discussed included the possible designation of the Chicot Aquifer as a sole-source aquifer in Louisiana as well as general questions concerning the Survey report schedule and Survey Sampling and Analysis quality assurance.

Summary of Findings

The major preliminary findings of the Environmental Survey for the SPR are as follows:

- Leaks in cavern pads, cavern pad drain valves, and cavern pad containment dikes would lead to a release of brine or crude oil to the environment in the event of a spill.
- Possible leakage from brine ponds could serve as a potential source of groundwater contamination of the underlying aquifer or to degradation of surrounding freshwater wetlands.
- Inactive waste sites may be potential sources of soil, groundwater, and/or surface-water contamination at Bryan Mound and Bayou Choctaw.
- There are unauthorized emissions of volatile organic compounds to the atmosphere from crude-oil surge tanks as a result of excessive gaps between floating-roof seals and tank walls at St. James Marine Terminal.
- The release of untreated Aqueous Film Forming Foam during fire training exercises and system performance tests can possibly result in severe oxygen depletion of nearby wetland receiving waters.
- There is a potential for releases of oil and chemical materials into the environment from drum storage areas and above-ground tanks lacking effective spill containment.

Overall Conclusions

The Survey found no environmental problems at the SPR that represent an immediate threat to human life. At present, the most pressing environmental problems facing SPR are the potential release of brine or crude oil to the environment from leaks in cavern pads in the event of a spill; possible leakage from brine ponds contaminating groundwater or degrading freshwater wetlands; and the potential for soil, groundwater, and/or surface water contamination from inactive waste sites.

The environmental problems described in this report vary in terms of their magnitude and risk. Although the Survey-related sampling and analysis to be performed at SPR will assist in further identifying environmental problems, a complete understanding of the significance of some of the environmental problems identified requires a level of study and characterization that is beyond the scope of the Survey. Actions currently under way or planned at the SPR, such as groundwater monitoring to determine possible brine pond leakage, will contribute toward meeting this requirement. Additionally, corrective actions have been initiated at SPR following the on-site Survey to resolve many of the preliminary findings.

Transmittal and Follow-up of Findings

The findings of the Environmental Survey for SPR were shared with the DOE SPR Project Management Office and SPR contractor at the Survey closeout briefings held on December 11, 1987, and February 10, 1988. The Office of Environmental Guidance and Compliance (OEG) was briefed on the Survey findings that resulted from the first segment of the SPR on-site Survey on January 22, 1988. A copy of the Survey findings resulting from the second segment of the SPR Survey was provided to OEG on March 7, 1988. By April of 1988, the SPR management staff had developed the draft action plans to address the Survey preliminary findings from both segments of the Survey. A final action plan addressing all the Survey preliminary findings cited herein will be prepared by SPR staff within 45 days after receiving this Preliminary Report. Those problems that involve extended studies and multiyear budget commitments will also be the subject of the Environmental Survey Summary Report and the DOE-wide prioritization.

Within the Office of the Assistant Secretary for Environment, Safety and Health, the OEG has immediate responsibility for monitoring environmental compliance and the status of the SPR Survey findings. The Office of Environmental Audit will continue to assess the environmental problems through a program of systematic environmental audits that will be initiated toward the conclusion of the DOE Environmental Survey in 1989.

1.0 INTRODUCTION

The purpose of this report is to present the preliminary findings made during the Environmental Survey, November 30 through December 11, 1987, and February 1 through February 10, 1988, of the Department of Energy's (DOE) Strategic Petroleum Reserve (SPR) located on the Texas and Louisiana Gulf Coast. As a Preliminary Report, the contents are subject to revisions. Revisions to the preliminary findings, based on technical review by the Oak Ridge Operations Office (ORO) and the SPR Project Management Office (PMO), and the results of the sampling and analysis program, will be incorporated into the Environmental Survey Summary Report. SPR is operated for DOE by Boeing Petroleum Services (BPS), Inc.

The SPR Survey is part of the larger, DOE-wide, Environmental Survey effort announced by Secretary John S. Herrington on September 18, 1985. The purpose of this effort is to identify, via "no fault" baseline Surveys, existing environmental problems and areas of environmental risk at DOE facilities and to rank them on a DOE-wide basis. This ranking will enable DOE to more effectively establish priorities for addressing environmental problems and to allocate the resources necessary to correct these problems. Because the Survey is "no fault" and is not an "audit," it is not designed to identify specific, isolated incidents of noncompliance or to analyze environmental management practices. Such incidents and/or management practices will, however, be used in the Survey as a means of identifying existing and potential environmental problems.

The SPR Environmental Survey was conducted by a multidisciplinary team of technical specialists headed and managed by a Team Leader and Assistant Team Leader from DOE's Office of Environmental Audit. A complete list of the SPR Survey participants and their affiliations is provided in Appendix A.

To make the preliminary findings included in this report, the Survey team focused on all environmental media, using Federal, state, and local environmental statutes and regulations; accepted industry practices; and professional judgment. The team carried out its activities in accordance with the guidance and protocols in the Environmental Survey Manual (August 1987). Substantial use of existing information and of interviews with knowledgeable PMO and site-contractor personnel accounted for a large part of the on-site effort. The Survey Plan is presented in Appendix B, and a summary of the site-specific Survey activities is presented in Appendix C. Appendix D is a list defining symbols, abbreviations, and acronyms used in this report.

The preliminary Survey findings, in the form of existing and potential environmental problems, are presented in Sections 3.0 through 9.0. Section 3.0 covers Bryan Mound (Texas); Section 4.0, Big Hill

(Texas); Section 5.0, Sulphur Mines (Louisiana); Section 6.0, West Hackberry (Louisiana); Section 7.0, Weeks Island (Louisiana); Section 8.0, Bayou Choctaw (Louisiana); and Section 9.0, St. James Marine Terminal (Louisiana). Findings that pertain to a specific environmental medium (e.g., air or surface water), as well as those that are non-media specific (e.g., waste management, quality assurance, and inactive waste sites) are included in each section. Because the findings are highly varied in terms of magnitude, risk, and characterization and consequently require different levels of management attention and response, they are further subdivided into four categories within each Section.

The criteria for placing a finding into one of the four categories are as follows:

- Category I includes only those findings which, based upon the information available to the Team Leader, involve immediate threat to human life. Findings of this type shall be immediately conveyed to the responsible environmental safety and health personnel at the scene or in control of the facility or location in question for action. Category I findings are those environmental problems where the potential risk is highest; the confidence in the finding, based on the information available, is the strongest; and the appropriate response to the finding is the most restrictive in terms of alternatives.
- Category II findings encompass one or more of the following situations:
 - Multiple or continuing exceedances, past or present, of a health-based environmental standard where there is immediate potential for human population exposure, or a one-time exceedance where residual impacts pose an immediate potential for human population exposure.
 - Evidence that a health-based environmental standard may be exceeded, as discussed in the preceding situation, within the time-frame of the DOE-wide Survey.
 - Evidence that the likelihood is high for an unplanned release due to, for example, the condition or design of pollution abatement or monitoring equipment or other environmental management practices.
 - Noncompliance with significant regulatory procedures, (i.e., those substantive technical regulatory procedures designed to directly or indirectly minimize or prevent risks, such as inadequate monitoring or failure to obtain required permits).

Category II findings include those environmental problems where the risk is high but where the definition of risk is broader than in Category I. The information available to the Team Leader is adequate to identify the problem but may be insufficient to fully characterize it. Finally, in this category, most discretion is available to the Operations Offices and Program Offices as to the appropriate response; however, the need for that response is such that management should not wait for the completion of the entire DOE-wide Survey to respond. Unlike Category I findings, a sufficient, near-term response by the Operations Office may include further characterization prior to any action taken to rectify the situation.

- Category III findings encompass one or both of the following criteria:
 - The existence of pollutants or hazardous materials in the air, water, groundwater, or soil resulting from DOE operations that pose or may pose a hazard to human health or the environment.
 - The existence of conditions at a DOE facility that pose or may pose a hazard to human health or the environment.

Category IV findings are those environmental problems for which the broadest definition of risk is used. As in Category II, the information available to the Team Leader may not be sufficient to fully characterize the problem. Under this strategy, the range of alternatives available for response, and the corresponding time frames for response, are the greatest. Environmental problems included within this category will typically require lengthy investigation and remediation phases and multiyear budget commitments. These problems will be included in the DOE-wide prioritization effort to ensure that DOE's resources are used most effectively.

In general, the levels of pollutants or materials that constitute a hazard or potential for hazard are those that exceed some Federal, state, or local regulations for release of, contamination by, or exposure to such pollutants or materials. However, in some cases, the Survey may determine that the presence of some nonregulated material is in such a concentration that presents a concern for local populations or the environment that is sufficient to be included as an environmental problem. Likewise, the presence of regulated materials in concentrations that, even below those established by regulatory authorities, nevertheless present a potential for hazard or concern, may be classified as an environmental problem. In general, however, conditions that meet regulatory or other

requirements, where such exist, should not present a potential hazard and will not be identified as environmental problems.

Conditions that pose or may pose a hazard are generally those which are violations of regulations or requirements (e.g., improper storage of hazardous chemicals in unsafe tanks). Such conditions present a potential hazardous threat to human health and the environment and should be identified as an environmental problem. Additionally, potentially hazardous conditions are those where the likelihood of the occurrence of release is high. The definition of the term "environmental problem" is broad and flexible to allow for the wide difference among the DOE sites and operations. Therefore, a good deal of professional judgment must be applied to the identification of environmental problems.

- Category IV findings include instances of administrative noncompliance and management practices that are indirectly related to environmental risk, but are not appropriate for inclusion in Categories I-III. Such findings can be based upon any level of information available to the Team Leader, including direct observations by the team members. Findings in this category are generally expected to lend themselves to relatively simple, straightforward resolution without further evaluation or analysis. These findings, although not part of the DOE-wide prioritization effort, will be passed along to the Operations Office and appropriate Program Office for their action.

Based on the professional judgment of the Team Leader, the findings within categories are arranged in order of relative significance. Comparing the relative significance of one finding to another, either between categories within a section or within categories between sections, is neither appropriate nor valid. The categorization and listing of findings in order of significance within this report is only the first step in a multi-step iterative process to prioritize DOE's problems.

The subsequent phase of the SPR Survey will involve sampling and analysis (S&A). Idaho National Engineering Laboratory will provide the S&A team for the SPR Survey. Prior to sampling, an S&A plan will be prepared in accordance with the protocols in the Survey Manual. The S&A plan will be designed to fill existing data gaps or weaknesses. The results generated by the S&A effort will be used to assist the Survey team in further defining the existence and extent of potential environmental problems identified during the Survey.

It is clear that certain of the findings and observations contained in this report can and should be addressed in the near-term (i.e., prior to the DOE-wide prioritization effort). It is also clear that the

findings and observations in this report vary greatly in terms of magnitude, risk, and characterization. Consequently, the priority, magnitude, and timeliness of near-term responses will require careful planning to ensure appropriate and effective application. The information in this Preliminary Report, albeit provisional, will assist the ORO and PMO in the planning of near-term responses that upon publication of this report have not yet been initiated.

As required in the December 2, 1987, memorandum from the Assistant Secretary for Environment, Safety and Health to the Operations Office Managers, entitled Follow-up of Environmental Survey Findings, the Oak Ridge Operations Office will prepare and submit a final action plan to the Deputy Assistant Secretary for Environment within 45 days of receiving this Preliminary Report. The final action plan for the SPR Survey will address all of the preliminary findings cited herein.

PRELIMINARY

2.0 GENERAL SITE INFORMATION

2.1 Site Setting

2.1.1 Historical Background

The Energy Policy and Conservation Act, signed into law on December 22, 1975, authorized the creation of the Strategic Petroleum Reserve (SPR). In this Act, the Congress declared it to be the policy of the U.S. Government to provide for storage of up to 1 billion barrels of crude oil and petroleum products. The purpose of the program was to diminish U.S. vulnerability to the effects of disruptions in petroleum supplies and thus ensure meeting U.S. obligations under the International Energy Program.

A program plan entitled "The SPR Plan" was developed and subsequently amended that authorized the implementation of a Government Reserve of 750 million barrels with an ultimate SPR storage objective of 1 billion barrels of petroleum (1 barrel = 42 gallons).

In developing the SPR system, several different types of storage facilities were considered. These included the use of existing solution-mined cavities and conventional mines in salt formations, the use of existing and the construction of new conventional surface tankage, and the use of surplus tanker ships. Salt domes that occur along the Gulf Coast of the United States were found to be attractive sites for petroleum storage caverns because of a relatively low construction cost, the geologic stability of caverns, and the impermeability of the salt (making it a suitable material in which to store petroleum products). Storage sites were selected in areas where they would be most accessible to major crude-oil pipelines and port facilities. As a result, the SPR storage system was physically connected to three major interstate pipelines--Seaway, Texoma, and Capline--for distribution of significant quantities of crude oil to eastern Oklahoma and Midwest refining areas.

The development plan has involved the construction of six underground crude-oil storage facilities in salt domes at Bryan Mound and Big Hill in Texas and at West Hackberry, Sulphur Mines, Bayou Choctaw, and Weeks Island in Louisiana, as well as construction of a marine terminal at St. James, Louisiana (Figure 2-1). The original planned storage capacity and drawdown rate for each of the six sites are shown in Table 2-1 along with a 1986 revised plan, which provides for the future decommissioning of the Sulphur Mines facility.

FIGURE 2-1

SITE LOCATIONS STRATEGIC PETROLEUM RESERVE

TABLE 2-1

**STORAGE AND DRAWDOWN CRITERIA
STRATEGIC PETROLEUM RESERVE**

Storage Group	Storage Facilities	Original Plan			1986 Revised Plan		
		Storage ⁽¹⁾ Capacity (MMB)	Crude Mix (Sweet/Sour)	Drawdown ⁽²⁾ Capacity (MMB/D)	Storage Capacity (MMB)	Crude Mix (Sweet/Sour)	Drawdown Capacity
Seaway Group	Bryan Mound	226	66/160	1,100	226	66/160	1,100
Texoma Group	Big Hill Sulphur Mines West Hackberry	140	70/70	930	160	69/91	930
		26	0/26	100 (3)	—	—	—
		219	113/106	1,400 (3)	219	113/106	1,400
		385	183/202	2,330 (4)	379	182/197	2,330
Capline Group	Weeks Island Bayou Choctaw	73	0/73	590	73	0/73	590
		66	28/38	480	72	34/38	480
		139	28/111	1,070	145	34/111	1,070
Total		750	277/473 37%/63%	4,500	750	282/468 38%/62%	4,500

Source: DOE, 1987.

(1) MMB = Million Barrels

(2) MB/D = Thousand Barrels per Day

(3) Drawdown capacity for individual site; if both sites are drawn from simultaneously, the combined drawdown capacity is 1,400 MB/D. Pipeline can handle only 1,400 MB/D.

(4) Sum of Big Hill (930 MB/D) and pipeline capacity (1,400 MB/D).

The locations of these sites and the associated distribution pipelines and terminals are shown in Figure 2-2. The marine terminal at St. James, Louisiana, serving the Bayou Choctaw and Weeks Island sites, is owned by the U.S. Department of Energy (DOE); the other terminals are privately owned and under contract to provide the required services for cavern fill and drawdown.

In 1984, the privately owned Seaway and Texoma pipelines were sold and subsequently converted to natural-gas transmission. As a result, SPR initiated distribution enhancements, which involved construction of pipelines and contractual arrangements with commercial terminals, to achieve the planned 4.5-million-barrel-per-day drawdown capability.

2.1.2 Climatology

The climate of the Gulf Coast area of Texas and Louisiana is classified as humid, subtropical with a strong maritime influence. The movement of maritime air from the Gulf of Mexico helps to temper extremes of summer heat and to shorten the duration of winter cold spells while providing abundant moisture and rainfall. However, temperatures exceeding 90°F generally occur more than 70 days per year in the area between Port Arthur and New Orleans, while at Galveston, 90°F is exceeded only about 12 days per year. Temperatures below freezing (32°F) are infrequent, occurring less than about 26 days per year (less than 5 days per year at Galveston). Precipitation over the area ranges from 42 inches per year at Galveston to about 57 inches per year at New Orleans and is distributed fairly uniformly throughout the year. Measurable snowfall is rare. The entire area is subject to hurricanes with high winds, heavy rainfall, and tidal flooding.

Air-flow patterns for 5-year periods at Galveston, Lake Charles, and New Orleans show that winds from the western quadrants are infrequent and of low velocity. At Galveston, the prevailing winds are from the southeastern quadrant with another prominent wind from the north. Southerly winds predominate at Lake Charles with only slightly less influence of winds from the east-northeast and north. Northerly winds are prevalent at New Orleans, but southerly winds are only slightly less frequent.

2.1.3 Regional Geology

The seven Strategic Petroleum Reserve sites lie within the Gulf Coast section of the Coastal Plain physiographic province. Structurally, the area is on the northern flank of a gulfward-dipping geosynclinal basin. A geosyncline is a large, generally linear trough that subsided deeply throughout a long period of time as it received a voluminous accumulation of sediments. The regional axis of the

FIGURE 2-2

LOCATIONS OF STORAGE SITES, TERMINALS, AND PIPELINES
STRATEGIC PETROLEUM RESERVE

geosyncline roughly corresponds to the coastlines of Texas, Louisiana, Mississippi, Alabama, and Florida. The geosyncline contains up to 50,000 feet of silts, sands, shales, limestones, and evaporites. Evaporites are sedimentary rocks consisting of minerals such as salt or gypsum, which were precipitated from evaporating waters.

The salt domes of the Gulf Coast were formed from a thick (1,000 to 5,000 feet) layer of evaporites known as the Louann Salt. After the deposition of this salt layer, sedimentation and subsidence continued until the density of the sediment pile over the salt was greater than the density of the salt itself. The salt began to flow upward in dome-shaped structures that pierced the overlying sediments.

A caprock made up of insoluble material can form over the dome. Salt (halite, NaCl) itself is water-soluble, but it contains variable amounts of insoluble anhydrite (anhydrous calcium sulfate, CaSO_4). The processes thought to be involved in caprock formation have been described (Walker, 1974) as follows: when a salt dome rises through the basin sediments, it eventually comes into contact with zones of groundwater that dissolve away the upper portion of the salt, leaving the insoluble crystals of anhydrite as a residue. These anhydrite crystals are then compacted and recrystallized to form the massive anhydrite caprock. This anhydrite caprock may react with water to form gypsum. The calcite and sulfur commonly present in caprock are thought to be alteration products from the reduction of anhydrite. The reducing agent in the alteration process may be hydrocarbons or dead organic matter (Walker, 1974).

The presence of sulfur in caprock accounts for early exploitation of the salt domes at Sulphur Mines, Louisiana, and Bryan Mound, Texas. The presence of anhydrite in the salt itself creates the need for disposal of insolubles from brine production or cavern-leaching operations. The numerous oil and gas operations surrounding the domes are present because structural traps for oil and gas are created at the edges of the dome, where layers of sediments have been upturned and then pierced.

Sediments of Tertiary age (Miocene and Pliocene) surround the domes. These sediments generally contain sand layers in which groundwater is already saline. Such layers are therefore suitable for brine disposal by means of injection wells. Younger overlying sediments of Pleistocene age were deposited during periods of retreat of continental glaciers. During these interglacial periods, large loads of sediments were deposited in river valleys, deltas, and shallow seas by meltwaters from the glaciers.

These Pleistocene depositional units are known, from oldest to youngest, as the Williana, Bentley, Montgomery, and Prairie Formations and are correlated with the Aftonian, Yarmouth, Sangamon,

and Peorian interglacial stages (Whiting, 1981). Each unit grades from coarse to fine sediments. The coarser subunits, as described below, are important water-bearing sands within the regional Chicot aquifer.

2.1.4 Regional Hydrogeology

The important regional aquifer is the Chicot aquifer system, which is composed of sands and gravels of Pleistocene age. The Chicot overlies the Evangeline and Jasper aquifers and is itself overlain near major rivers by alluvial deposits of Holocene (Recent) age. The Evangeline aquifer is of Pliocene and Miocene age, and the Jasper aquifer is of Miocene age. The freshwater/saltwater interface within this sequence of aquifers varies from one location to another, depending primarily on proximity to the Gulf of Mexico. In general, the Chicot is a freshwater aquifer (less than 250 mg/L of chloride, less than 1,000 mg/L of total dissolved solids [TDS]), while the Evangeline and Jasper aquifers are slightly saline (1,000-3,000 mg/L TDS) to saline (greater than 3,000 mg/L TDS). The use of these aquifers varies considerably because of the variable salt content. For example, the Evangeline aquifer is a freshwater source in the northern part of Calcasieu Parish, the parish in which the Sulphur Mines site is located. However, this aquifer is used for saltwater disposal in the central and southern parts of the parish (Whiting, 1981). In general, brine disposal operations in the Gulf Coast region involve the Jasper aquifer and deeper sands.

In the Lake Charles industrial area, near the Sulphur Mines and West Hackberry SPR sites, the Chicot aquifer system has been subdivided into the "700-foot," "500-foot," "200-foot," and "shallow" sands. These subdivisions have been correlated with the Williana, Bentley, Montgomery, and Prairie Formations, which correspond to the four interglacial periods of Pleistocene glacial history. Both east and west of the Lake Charles area, the clay layers separating the "700-foot" and "500-foot" sands become less distinctive, and the terms "lower sand unit" or "lower aquifer" are used to describe the combined unit (SAW, 1986). The "upper sand unit" or "upper aquifer" is equivalent to the "200-foot" sand.

The natural groundwater flow direction is southward towards the Gulf of Mexico, but this natural direction has been changed by heavy groundwater pumping in areas such as Lake Charles and Lafayette, Louisiana. Such pumping encourages saltwater encroachment northward from the Gulf.

Groundwater is heavily used throughout the region except for areas nearest to the coast, where it is too salty, or in the vicinity of major rivers, where surface water provides an alternative. The major uses are for irrigation (particularly rice farming), public water supplies, and rural domestic use. Details of groundwater use may be found in a petition to designate the Chicot aquifer system as a

sole-source aquifer for southwestern and south-central Louisiana (SAW, 1986) or in site-specific SPR Environmental Impact Statements (SPRO, 1976; 1977a, b; and 1978a, b).

The sole-source-aquifer petition, which is sponsored by a nonprofit corporation known as Save Acadia's Water, was filed with the EPA in December, 1986. It would affect only Louisiana and not Texas, although the Chicot aquifer system is present in both states. The SPR sites affected would be Sulphur Mines, West Hackberry, and Weeks Island. The eastern Louisiana SPR sites, St. James Terminal and Bayou Choctaw, are not included in the area of the petition. These eastern sites are located in proximity to a major surface-water supply source, the Mississippi River.

It is unclear what effect this sole-source petition, if granted, would have on SPR operations, because regulations prohibiting any contamination of underground sources of drinking water already exist. However, approval of the petition would probably result in additional lead time on projects at SPR, because of the requirement for EPA review of federally funded projects in sole-source-aquifer designated areas.

2.2 Overview of Major Site Operations

Through fiscal year 1986, the SPR had achieved a total storage capacity of 540 million barrels and had completed the development of two storage facilities (Sulphur Mines and Weeks Island) and the St. James Marine Terminal. Completion of the reserve to 750 million barrels requires the continued development of additional capacity by solution mining (leaching) of new caverns at three of the six sites (DOE, 1986a).

Storage space for oil is created by dissolving (leaching) salt within a salt dome to form a cavern. A typical cavern is designed to hold 10 million barrels of crude oil. However, the total volume of a cavern is greater than 10 million barrels because space is provided for about 1 million barrels of brine beneath the oil and for a sump at the bottom of the cavern. The purpose of the sump is to provide room for insoluble materials from the salt to settle out. If leaching is done slowly, soluble salt will remain in solution while anhydrite and other insolubles present in the salt dome will settle to the sump. However, at more rapid leach rates, insolubles will be carried out of the cavern along with the brine solution.

The process is essentially the same as that used for solution mining of salt to produce a brine feedstock for chemical processes. However, it is carefully controlled to produce a storage cavern of appropriate size and shape.

To create a storage cavern, a pair of wells (known as A and B) are drilled into the salt dome. The wells are approximately 40 feet apart. Well B is used for sump leaching (Figure 2-3). Fresh water is injected through a 7-inch-diameter suspended casing (tubing string) at a depth of approximately 4,500 feet. As fresh water is pumped into the wells to leach the salt, brine (water containing dissolved salt) is produced. As more fresh water is injected, brine is displaced from the cavern. This brine is disposed of through pipelines to the Gulf of Mexico, or by injection through disposal wells into saltwater-bearing rock formations near the salt domes.

An oil blanket is used to stabilize the top of the cavern as the bottom is leached. Sump development is continued until the enlarging cavern coalesces with Well A. When this process is complete, the 7-inch casing is permanently removed from Well B, using a workover rig.

Chimney leaching is then performed by injecting fresh water through a 10-3/4-inch-diameter suspended casing in Well B and removing brine through the same size and type of casing in Well A (Figure 2-4). This process is continued until the cavern volume reaches approximately 2.6 million barrels. A sonar survey is performed at this stage to check the cavern diameter and verify the calculated volume.

Roof development (first reverse) is done by injecting water into Well A and removing brine through Well B (Figure 2-5). This circulation pattern is the reverse of that used in earlier stages, in which Well B was used for water injection. The cavern volume is increased during this stage to approximately 4.9 million barrels. A domed roof is formed by injecting more blanket oil to move the oil/brine interface downward in a stepwise manner during leaching. A completed roof has a typical height of 50 feet and width of 250 feet.

The second reverse stage is carried out after another sonar survey and a workover to lower the depth of the 10-3/4-inch casing in Well A. Reverse circulation is again used to leach the remainder of the cavern (Figure 2-6) to develop a volume of 12.9 million barrels. After leaching is complete, casing depth is adjusted in another workover. The suspended casing in Well A is designated for oil injection and withdrawal; the suspended casing in Well B is used for water and brine movements. Mechanical integrity testing is performed before the cavern is used for oil storage (BPS, 1987a).

FIGURE 2-3

TYPICAL CAVERN LEACHING AT BIG HILL
 STAGE I: SUMP DEVELOPMENT
 STRATEGIC PETROLEUM RESERVE

FIGURE 2-4

TYPICAL CAVERN LEACHING AT BIG HILL
 STAGE II: CHIMNEY FORMATION
 STRATEGIC PETROLEUM RESERVE

FIGURE 2-5

TYPICAL CAVERN LEACHING AT BIG HILL
 STAGE III: ROOF DEVELOPMENT (FIRST REVERSE)
 STRATEGIC PETROLEUM RESERVE

FIGURE 2-6

TYPICAL CAVERN LEACHING AT BIG HILL
 STAGE IV: SECOND REVERSE
 STRATEGIC PETROLEUM RESERVE

2.3 State/Federal Concerns

As part of the pre-Survey site visit, three separate meetings were held on October 14 and 15, 1987, with officials from the Environmental Protection Agency, Region VI, and the states of Louisiana and Texas to brief them on the Survey effort and to solicit and discuss their input on the environmental status of the SPR.

The Louisiana Department of Environmental Quality (DEQ) indicated that past brine and oil spills have been properly handled. In a matter not directly related to the Survey, the Louisiana Department of Natural Resources (DNR) requested that it be provided with the results of the semiannual safety inspections of solution cavern storage wells conducted by SPR under State-Wide Order 29M.

The meeting with the regional EPA was primarily a question-and-answer session, with representatives of EPA asking for a tentative Survey report schedule (i.e., when the Preliminary Report is scheduled for completion). The Federal Facilities Compliance Coordinator requested a meeting with SPR-PMO after the Preliminary Report is released to discuss the preliminary findings. Information was also provided to the regional office on the role of EPA's Environmental Monitoring Systems Laboratory in the Survey (i.e., Sampling and Analysis QA support and data validation). Additionally, the regional office brought to the Survey's attention the possible designation, under the Safe Drinking Water Act, of the Chicot Aquifer as a sole-source aquifer in Louisiana.

The State of Texas representatives informed the Survey of the existence of compliance files on the SPR in their Beaumont Area Office. However, the state representatives did not believe these files would reveal any information not already known to the SPR and maintained in the SPR-PMO files provided to the Survey. The SPR-PMO informed the Survey that the Railroad Commission of Texas (RCT) was the principal regulatory agency over the Texas SPR sites (i.e., regulates injection wells and caverns). Although RCT was invited to the meeting, it was not represented.

3.0 BRYAN MOUND

The Bryan Mound site is located in Brazoria County, Texas, about 3 miles southwest of Freeport, Texas, near the Gulf of Mexico and 65 miles south of Houston, Texas (Figure 3-1). The site occupies 499 acres in the southwest apex of a triangle formed by the Brazos River Diversion Channel, the Old Brazos River, and the Intracoastal Waterway. Bryan Mound is a slightly elevated area surrounded by coastal marshes. The major water bodies near the site are Blue Lake to the north and Mud Lake to the south. These water bodies generally define the mounded aspect of the Bryan Mound dome, which creates a surface expression in the terrain by rising approximately 20 feet above the surrounding wetlands. Marsh and spoil areas lie on the southern perimeter of the Bryan Mound site.

The Bryan Mound site is located within an area that is highly industrialized, with petroleum-related facilities representing a significant share of the economy. To the east of the site is an area classified as made-land, an area graded and filled with spoil or other material. It has been utilized for urban-residential and industrial expansion. This type of area is commonly developed over marsh and reclaimed land. Approximately 1/2 mile east are facilities of Phillips Petroleum and Houston Natural Gas. Farther to the east are the Freeport Harbor facilities. The estimated population for the Houston-Galveston-Brazoria Metropolitan Statistical Area (MSA) for 1984 was 3,565,656. Of that population, Houston accounted for 3,164,177 (USBC, 1986).

The Bryan Mound storage site was acquired in 1977, at which time four existing brine caverns with a total capacity of 66 million barrels were converted to crude-oil storage. In 1986, development of 16 new 10-million-barrel storage caverns increased the site's total storage capacity to 226 million barrels (DOE, 1987). At the time of the on-site Environmental Survey, about 20-million barrels of that capacity remained to be filled with crude oil.

3.1 Media-Specific Survey Findings

The discussions in this section pertain to existing or potential environmental problems in the air, surface water, and groundwater/soil media. The discussions include a summary of the available background environmental information related to each medium, a description of the sources of pollution and their control techniques, a review of the environmental monitoring program specific to each medium, and a categorization and explanation of the environmental problems found by the Survey team related to each medium.

FIGURE 3-1

BRYAN MOUND, TEXAS, SITE LOCATION STRATEGIC PETROLEUM RESERVE

3.1.1 Air

3.1.1.1 Background Environmental Information

The air portion of the Environmental Survey of the Bryan Mound Site is designed to address existing and potential environmental impacts associated with releases of contaminants to the atmosphere, and includes a critical evaluation of air pollution sources and controls, and compliance with air pollution regulations. Adherence to established environmental procedures is evaluated from the standpoint of environmental problems or risks. Principal regulations relating to air emissions used as guidance during the Survey include the following:

- The Clean Air Act (CAA) and Amendments
- Federal Regulations, including
 - National Ambient Air Quality Standards (NAAQS) (40 CFR 50)
 - Standards of Performance for New Stationary Sources (40 CFR 60)
 - National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61)
- Texas Air Control Board Rules and Regulations

The Bryan Mound salt dome is located on the Texas Gulf Coast, in Brazoria County, which is part of Metropolitan Houston-Galveston Intrastate Federal Air Quality Control Region (AQCR) No. 216 (40 CFR 81.38, July 1, 1987).

The national ambient air quality standards, shown in Table 3-1, have been incorporated into Texas air pollution control regulations and are enforced throughout the state. The attainment status of AQCR No. 216 is described (40 CFR 81.344, July 1, 1987) as follows:

Parameter	Status
Total Suspended Particulates	Better than National Standards
Sulfur Dioxide	Better than National Standards
Ozone	Does not meet Primary Standards
Carbon Monoxide	Cannot be Classified or Better than National Standards
Nitrogen Dioxide	Cannot be Classified or Better than National Standards

TABLE 3-1

NATIONAL AMBIENT AIR QUALITY STANDARDS

Parameter	Averaging Time	National Standards ⁽¹⁾	
		Primary ⁽²⁾	Secondary ⁽³⁾
Ozone	1 hour	235 $\mu\text{g}/\text{m}^3$ (0.12 ppm)	Same as Primary
Carbon Monoxide	8 hour	10 mg/m^3 (9.0 ppm)	Same as Primary
Carbon Monoxide	1 hour	40 mg/m^3 (35 ppm)	Same as Primary
Nitrogen Dioxide	Annual Arithmetic Mean	100 $\mu\text{g}/\text{m}^3$ (0.05 ppm)	Same as Primary
Sulfur Dioxide	Annual Arithmetic Mean	80 $\mu\text{g}/\text{m}^3$ (0.03 ppm)	Same as Primary
Sulfur Dioxide	24 hour	365 $\mu\text{g}/\text{m}^3$ (0.14 ppm)	Same as Primary
Sulfur Dioxide	3 hour	--	1,300 $\mu\text{g}/\text{m}^3$ (0.5 ppm)
Suspended Particulate Matter	Annual Geometric Mean	75 $\mu\text{g}/\text{m}^3$	60 $\mu\text{g}/\text{m}^3$
Suspended Particulate Matter	24 hour	260 $\mu\text{g}/\text{m}^3$	150 $\mu\text{g}/\text{m}^3$
PM-10 Particulate Matter ⁽⁴⁾	Annual Arithmetic Mean	50 $\mu\text{g}/\text{m}^3$	Same as Primary
PM-10 Particulate Matter ⁽⁴⁾	24 hour	150 $\mu\text{g}/\text{m}^3$	Same as Primary
Lead (Pb)	Quarterly Arithmetic Mean	1.5 $\mu\text{g}/\text{m}^3$	Same as Primary

Source: 40 CFR 50 and 52 FR 24663.

- (1) These standards, other than for ozone and those based on annual average or annual geometric means, must not be exceeded more than once per year. The ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.
- (2) National primary standards are the levels of air quality necessary, with an adequate margin of safety, to protect the public health.
- (3) National secondary standards are the levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
- (4) Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers. Standard promulgated July 1, 1987.

The status of other criteria pollutants, including PM-10 particulate matter and lead, has not been published.

Wind data recorded at Galveston, Texas, which is about 40 miles northeast of Bryan Mound, are representative of air-flow patterns along that section of the Gulf Coast. Characteristic wind patterns for stations near the SPR sites are discussed in Section 2.1.

3.1.1.2 General Description of Pollution Sources/Controls

Facilities at Bryan Mound that have potential for emissions to the atmosphere are covered by construction and operating permits (No. C-6176B and No. R-6176B, respectively) issued by the Texas Air Control Board (TACB, 1979, 1987). Those permits specifically address sources of volatile organic compound (VOC) emissions and establish maximum allowable emission rates. The sources and allowable emission rates are as follows:

Source of VOC Emissions	Maximum Allowable Emission Rate	
	Pounds Per Hour	Tons Per Year
Surge Tanks (4)	1.4	6.1
Sump Tanks (2)	<0.1	0.2
Oil/Brine Separation	2.7	11.8
Valve Stems and Pump Seals	0.6	2.6

These sources are located on the surface (except the two sump tanks that are underground) at Bryan Mound, as shown in Figure 3-2. They handle either crude oil or brine that may be contaminated with crude oil. Emissions of VOCs from these sources during the initial fill of the underground caverns are specifically exempted by the permits.

3.1.1.2.1 Surge Tanks

Four 200,000-barrel surge tanks are used to contain crude oil prior to injection in underground storage caverns or, in the future, during transfer of crude oil from the caverns to commercial terminals. The tanks are equipped with internal floating roofs with double seals to minimize emissions of VOCs. Standards of performance for storage vessels for petroleum liquids constructed after June 11, 1973, and prior to May 19, 1978 (40 CFR 60, Subpart K) are applicable because the construction contract award date was August 19, 1977 (Teerling, 1986a). Although not required by regulation or permit, monthly visual inspections of roof seals are conducted by BPS.

FIGURE 3-2

LOCATION OF AIR-EMISSION SOURCES AT BRYAN MOUND STRATEGIC PETROLEUM RESERVE

3.1.1.2.2 Sump Tanks

Two underground tanks are used to receive and contain any spilled oil from the high-pressure pump pad (BMT-5: capacity 1,000 gallons) or oil separated from brine in the oil/brine separator (BMT-6: capacity 6,000 gallons).

3.1.1.2.3 Oil/Brine Separation

A six-compartment oil/brine separator (capacity of each compartment is about 2,700 barrels) that was installed at Bryan Mound proved to be incapable of handling the relatively large volumes of anhydrite generated during early cavern-fill operations. The oil/brine separation was subsequently accomplished in the brine pond, which has a much larger volume capacity (150,000 barrels). On occasions when crude oil was discharged along with brine to the oil/brine separator or to the brine pond, VOC emissions to the atmosphere occurred. Because the project is nearing completion, the facility is approaching the static-storage stage, with little or no VOC emissions from oil/brine separation. The existing air operating permit will need to be maintained to cover VOC emissions during periodic crude-oil recirculation exercises.

3.1.1.2.4 Valve Stems and Pump Seals

VOC emissions are possible if valve stems and pump seals leak. The site has 83 valves and 13 pumps, which are located at the high-pressure pump pad, on the meter/prover skid, and at the cavern pads. These valves and pumps handle crude-oil transfers. Leaks and VOC emissions are controlled by an inspection and maintenance program, which includes VOC monitoring with a portable instrument.

3.1.1.2.5 Space Heating

Space heating at Bryan Mound is provided by electricity.

3.1.1.2.6 Fugitive Dust

The construction and operating permits for Bryan Mound do not include requirements for control of fugitive dust emissions.

3.1.1.3 Environmental Monitoring

3.1.1.3.1 Monitoring of Ambient Air Quality

A monitoring program was initiated by the site contractor at Bryan Mound on October 1, 1982 to determine baseline ambient air quality. The program continued through September 30, 1983 (York, 1984). Parameters monitored during that period were total suspended particulates, ozone, and nonmethane hydrocarbons. The total suspended particulate concentrations met both primary and secondary annual and 24-hour standards, while ozone exceeded the hourly standard (which is not uncommon in an AQCR designated as a nonattainment area for ozone). Although there are no current air-quality standards for nonmethane hydrocarbons, the maximum hourly average concentration was 5.6 parts per million (ppm) (York, 1984). There are no regulatory requirements for continued air-quality monitoring.

3.1.1.3.2 Calculation of Surge Tank VOC Emissions

A report of VOC emissions from the four surge tanks is prepared monthly and submitted quarterly to the Texas Air Control Board as required by the operating permit (TACB, 1987). Emission calculations are made using the latest edition of AP-42, "Compilation of Air Pollutant Emission Factors." The calculations, which are based on monthly throughput of crude oil, average temperature, and vapor pressure, have routinely shown that the emissions are below the allowable limits. Total VOC emission for 1987 (January through September) was 0.55 ton, as compared with the maximum allowable emission rate of 6.1 tons per year (Teerling, 1987a). There is no regulatory requirement for emissions reporting for the two small underground sump tanks.

3.1.1.3.3 Fugitive VOC Emissions

The construction permit issued for Bryan Mound requires monthly monitoring of valve stems and pump seals for fugitive VOC emissions (TACB, 1979). The purpose of monitoring is to assure that these potential sources are not leaking excessive amounts of VOC into the atmosphere. Texas regulations define a "leak" as an emission of 10,000 ppm of VOC. Monthly monitoring for Bryan Mound at "in service" valves and pumps using an organic vapor analyzer typically revealed VOC levels below the detection capability of the instrument. At the request of the SPR, the TACB, in the construction permit issued in June 1985 for Bryan Mound, reduced the frequency of monitoring to once per year (TACB, 1985).

3.1.1.4 Findings and Observations

3.1.1.4.1 Category I

None.

3.1.1.4.2 Category II

None.

3.1.1.4.3 Category III

None.

3.1.1.4.4 Category IV

None.

PRELIMINARY

3.1.2 Surface Water

3.1.2.1 Background Environmental Information

3.1.2.1.1 Surface-Water Bodies In the Area

Surface-water bodies adjacent to the Bryan Mound site, shown in Figure 3-3, are the Brazos River Diversion Channel on the west, Blue Lake to the north and west, and Mud Lake to the east and south. The Brazos River Diversion Channel intersects the Intracoastal Waterway (ICW) about 1 mile south of the site and enters the Gulf of Mexico about 2 miles south of the site (DOE, 1978a). As a result of being close to the Gulf, these waters are brackish and are influenced by the tides.

3.1.2.1.2 Sources of Water Used at the Site

Potable water is supplied to the site from the City of Freeport water distribution system. However, because of complaints about taste and quality, it is only used to supply water to toilets, sinks, and hose connections. Bottled water is supplied for drinking (Châtelain and Roberts, 1987). The other water uses at Bryan Mound are supplied from the raw water intake at the Brazos River Diversion Channel. These include water for leaching, oil drawdown, fire protection, and brine pump seal flushing.

3.1.2.1.3 Flood Plain

Hurricane surge studies indicate that the 100-year flood elevation at Bryan Mound is 12.0 feet above mean sea level (MSL). Therefore, the site would be subject to flooding if it were not protected by levees because elevations on the dome vary from 5 to 16 feet MSL. The levees along the Brazos River Diversion Channel and the Old Brazos River (in the City of Freeport) are about 19 feet MSL, while the levee to the south and east of the dome (East-West Levee Road) and along the Intracoastal Waterway is 17 feet MSL (DOE, 1978a).

The main operations area is within the protection of the levee. Only Cavern Pads 2, 106-110, and 112-116, as well as some outside maintenance and warehouse storage facilities, are outside the protection of the levees.

FIGURE 3-3

**SURFACE WATERS ADJACENT TO BRYAN MOUND
STRATEGIC PETROLEUM RESERVE**

3.1.2.2 General Description of Pollution Sources/Controls

3.1.2.2.1 Water Uses at Site

Although potable water is supplied to the site from the City of Freeport's water distribution system, it is only used to supply water for toilet flushing, hose connections, and sinks. Bottled water is used at the site for drinking. The other water uses at the site are supplied by raw water from the intake structure on the Brazos River Diversion Channel. This includes water for leaching (preparing the oil storage caverns as described in Section 2.2), brine pump seal flushing, and the fire protection system.

The bearing seals on the brine pumps must be continually flushed with fresh water to prevent their being damaged (eroded) by these materials in the brine. Because of the close tolerances involved in this application, the water used for seal flushing is filtered to remove any particulate matter in the fresh water. The sand filters that are used to remove the particulates from the raw water are backwashed to the large brine pond. A cationic polymer is fed ahead of the filters to aid in the flocculation and removal of the particulate matter.

The fire protection system is also supplied with water from the Brazos River Diversion Channel. The fire protection system at Bryan Mound, as is done at other SPR sites, uses Aqueous Film Forming Foam (AFFF) to improve the fire extinguishing capabilities of the system. This material is effective in covering and extinguishing hydrocarbon liquid-based fires. AFFF is obtained from a variety of suppliers through competitive bids. However, all the materials have similar characteristics of high biochemical and chemical oxygen demand (BOD and COD); are mostly biodegradable; contain 5 percent or less fluorocarbon surfactants, which are not biodegradable; and exhibit varying degrees of aquatic toxicity. They are, however, classified as practically nontoxic in the manufacturer's literature because the oral LD₅₀ for rats is greater than 5 grams per kilogram (g/kg). (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered.) The oxygen depletion, due to the high BOD and COD, coupled with the aquatic toxicity, could result in short-term environmental degradation if this material is released to adjacent surface water. The as-purchased concentrate is mixed with water to provide a 3 percent solution to be sprayed on the fire. The foam deluge system on the pump pads and oil surge tanks have automatic foam proportioning systems to provide the required mixture. The fire monitors (water cannons) at the cavern pads use eductors to siphon the concentrate directly from drums placed adjacent to the monitor. The mobile fire-fighting equipment is also capable of using AFFF. SPR procedures call for annual testing of the fire protection systems and training of personnel. SPR has estimated that 26,773 gallons of 3 percent AFFF solution would be generated annually in training and testing exercises at Bryan Mound. Because the AFFF is for the most part biodegradable, the

sewage treatment plant could treat the waste; however, the annual capacity of the existing systems for treating AFFF is only 1,217 gallons. In addition, while the dikes at the cavern wellpads and oil surge tanks would contain the foam used in fire-fighting or training exercises at those locations, there is no collection system in place at the pump pads. SPR has temporarily suspended testing and training requirements until the disposal problem has been resolved. At the time of the on-site portion of the Survey, SPR was continuing dialog with the state and investigating disposal options. Subsequent to the on-site portion of the Survey, the state ruled that fire-fighting fluids are oil-and-gas wastes and may be disposed of into Class II injection wells (Mullican, 1988). See Section 3.1.2.4.3 for a related finding.

3.1.2.2.2 Brine Disposal

Brine from the caverns, during leaching and filling operations, is delivered to the large (6.3 million gallon) brine pond to enable insoluble material (anhydrite) to settle out and any suspended oil to float to the surface. The pond is drained to allow removal of the solid material with a front-end loader into trucks. This operation had taken place three times prior to the on-site visit, the last being in November 1985. The anhydrite had been disposed of on-site, but since 1985, it now is taken off-site (Section 3.2.1.2). The recovered oil is reinjected back into the system. The brine is then pumped to the Gulf of Mexico at a rate that allows the exit velocity through the individual diffusers to meet or exceed the National Pollutant Discharge Elimination System (NPDES) permit limit of 20 feet/second. This rate has been established to permit adequate mixing with the sea water. If this was not done, a high salinity lens could develop on the floor of the Gulf in the diffuser area because the density of the brine discharge is greater than that of the sea water.

Oil/brine separators were installed ahead of the brine pond in the original design of the brine-handling system. However, they were only used for the first 2-3 months of operation because the oil could be removed just as effectively in the brine ponds without encountering the difficulties in keeping the anhydrite cleaned out of the separators.

The NPDES permit requires that the brine line to the Gulf of Mexico be hydrostatically tested every 6 months. It is not feasible to do this, because it would be necessary to close off the diffuser ports situated on the floor of the Gulf for each test. An alternative method utilizing duplicate calibrated flow meters, installed in the brine line at the site and also in the first diffuser in the Gulf, is being tested at West Hackberry. At the time of the on-site Survey, SPR was awaiting EPA's response to information that had been supplied to EPA on this alternative testing method.

3.1.2.2.3 Sanitary Sewage

The sanitary sewage at Bryan Mound is treated in an extended aeration, activated sludge, package sewage treatment plant located east of the guard house at the west gate on the levee road. This unit has a rated capacity of 5,000 gallons per day (gpd). Present loading from Bryan Mound generally averages 1,000 to 1,500 gpd. The effluent flows into the Brazos River Diversion Channel downstream of the raw water intake. Because of the system's small size and low flow rate, it is susceptible to upsets from cleaning solution being dumped into the sinks and toilets. Cleaning personnel have been cautioned against this practice, and the cleaning agents that they use have been closely regulated by the site.

3.1.2.2.4 Storm Water

Storm water from the site runs into Blue Lake from areas that are within the levee and into Mud Lake or the Brazos River Diversion Channel from those areas that are outside the levee. Those areas (such as the cavern wellpads, oil surge tanks, and pump pads) that have the greatest potential for spilling oil or brine are diked, and the storm water discharges through an oil/water separator. The oil/water separators at Bryan Mound are operated in a batch mode. That is, the influent valve is normally closed. When a storm event occurs, the water contained in the dike is analyzed and, if it meets the discharge limits (Section 3.1.2.3.1), it is allowed to be discharged. If it does not meet discharge limits, appropriate action would be taken. Skimming oil from the water in the dike prior to discharge, to reduce the load on the oil/water separator, or removing the water to the brine pond, if it has a high salinity, are examples of actions that might be taken (Salinas, 1987a).

The oil/water separator at the high-pressure pump pad is used solely as a storm-water collection tank. Because of a valve leak in the cross connection between the brine and raw water systems and because of the salinity in the raw water used as seal flush water, the water that flows off the pad is vacuumed out of the separator and trucked to the brine pond for disposal.

Cavern Pad 113 has been partially built on fill material on Mud Lake, and Cavern Pad 108 has been built on top of a portion of a former City of Freeport landfill. Through dye tests, the site personnel have determined that storm water has leaked from Pad 113 into the lake and suspect that Pad 108 may also be leaking. An interim solution to the Pad 113 leak has been to install a synthetic liner on the pad while studying the development of a permanent solution.

3.1.2.3 Environmental Monitoring Program

3.1.2.3.1 NPDES Monitoring

The discharges from Bryan Mound are regulated by National Pollutant Discharge Elimination System (NPDES) Permit No. TX0074012 issued by the U.S. Environmental Protection Agency (EPA) on June 4, 1985, and also by Water Discharge Permit 02271 issued by the Texas Water Commission (TWC) on February 5, 1985. These permits are due to expire February 2, 1989, and February 5, 1990, respectively.

The locations of the permitted discharge sampling points are shown in Figure 3-4. Although the NPDES Outfall 001 discharge is actually at the brine diffusers 12-1/2 miles offshore in the Gulf of Mexico, samples are taken from the brine line to the Gulf, before it leaves the pump pad. The storm-water discharge from the oil surge tank area has been designated as Outfall 001 in the TWC permit because the brine diffusers lie beyond the jurisdiction of the state. Samples for TWC001 and the samples for the cavern wellpad storm-water discharges are actually taken within the containment dikes, on the upstream side of the oil/water separators prior to discharge through the separators, rather than on the discharge side of the separators. There are a total of 25 storm-water monitoring points at Bryan Mound; the 20 cavern pads, 4 oil-surge tank dikes, and the high pressure pump pad. Table 3-2 contains a list of the parameters measured, their limits, and the sampling frequency for the outfalls at Bryan Mound. Although there are no permit requirements regarding salinity in the storm-water discharge, Bryan Mound analyzes the storm water for this parameter. If the salinity is higher than that of the adjacent surface water body to which the storm water would discharge, the storm water is taken by vacuum truck to the brine pond. Salinity in the water from the oil surge tanks, pump pads, and Cavern Pads 1, 4, 5, 101-105, and 111 are compared with Blue Lake, whereas those from Cavern Pads 2, 106-110, and 112-116 are compared with Mud Lake.

The only exceptions to the requirements of the permit in 1986 were at NPDES Outfall 001 on February 15, when a sample was not collected, and at Outfall 002 during the start-up of the sewage treatment plant on February 26 and 28, when both the Total Suspended Solids (TSS) and Biochemical Oxygen Demand (BOD) were out of compliance (i.e., BOD values of 65.0 and 69.5 mg/L, and TSS values of 56.0 and 50.0 mg/L as compared with the limit of 45 mg/L for both).

FIGURE 3-4

SURFACE-WATER SAMPLING LOCATIONS AT BRYAN MOUND STRATEGIC PETROLEUM RESERVE

TABLE 3-2

DISCHARGE MONITORING REQUIREMENTS AND EFFLUENT LIMITATIONS
BRYAN MOUND SITE
STRATEGIC PETROLEUM RESERVE

Outfall	Parameter	Minimum	Daily Average	Daily Maximum	Measurement Frequency ⁽¹⁾	Sample Type
001 Brine Diffuser to Gulf of Mexico ⁽²⁾	Flow	(3)	N/A	1.1 MBD/46.2 MGD	Continuous	Recorded
	Oil and Grease	N/A	10 mg/L	15 mg/L	1/day	Grab
	Total Suspended Solids	N/A	Report	Report	1/week	Grab
	Total Dissolved Solids	N/A	Report	Report	1/week	Grab
	pH	6.0 S.U.	N/A	9.0 S.U.	1/month	Grab
	Dissolved Oxygen ⁽⁴⁾	Detectable	N/A	N/A	1/day ⁽⁴⁾	Grab
	Oxygen Scavenger ⁽⁴⁾	N/A	N/A	10 ppm NH_4HSO_3 or 18 ppm K_2SO_3 per ppm D.O.	1/day ⁽⁴⁾	Calculation
002 Sanitary Sewage to Brazos River Diversion Channel	Flow	N/A	Report	Report	2/month	Instantaneous
	BOD ₅	N/A	20 mg/L 0.7 pounds/day	45 mg/L 1.5 pounds/day	2/month	Grab
	Total Suspended Solids	N/A	20 mg/L 0.7 pounds/day	45 mg/L 1.5 pounds/day	2/month	Grab
	pH	6.0 S.U.	N/A	9.0 S.U.	2/month	Grab
	Chlorine	1.0 mg/L	N/A	N/A	1/day ⁽⁴⁾	Grab

TABLE 3-2
DISCHARGE MONITORING REQUIREMENTS AND EFFLUENT LIMITATIONS
BRYAN MOUND SITE
STRATEGIC PETROLEUM RESERVE
PAGE TWO

Outfall	Parameter	Minimum	Daily Average	Daily Maximum	Measurement Frequency ⁽¹⁾	Sample Type
Storm-Water Runoff ⁽⁶⁾	Oil and Grease	N/A	N/A	15 mg/L	1/day	Grab
	Total Organic Carbon ⁽²⁾	N/A	N/A	75 mg/L	1/day	Grab
	pH	6.0 S.U.	N/A	9.0 S.U.	1/day	Grab
	Chemical Oxygen Demand ⁽⁷⁾	N/A	N/A	200 mg/L	1/day	Grab
	Flow	N/A	Report	N/A	1/day	Estimate

Source: NPDES Permit TX 0074012 and Texas Water Commission Permit 02271.

- (1) When discharge is occurring.
- (2) Federal Requirement Only.
- (3) The exit velocity at each operating diffuser is limited to a minimum of 20 feet per second.
- (4) Dissolved oxygen analysis is required only when an oxygen scavenger is being used. Bryan Mound does not and never has needed to feed an oxygen scavenger to prevent corrosion in the brine discharge line.
- (5) The Federal permit requires sampling 2/month; the state permit requires daily monitoring.
- (6) The discharge limits apply to the discharges from the oil/water separators at the various cavern pads, pump pad, and the surge tank area. The discharge from the oil/water separator at the surge tank area is designated outfall 001 in the state permit.
- (7) State Requirement Only.

3.1.2.3.2 Surface-Water Monitoring

Although there are no regulatory permit requirements to do surface-water monitoring, Bryan Mound takes samples of waters in Mud Lake and Blue Lake adjacent to the site to monitor any impact that the site may have on these bodies of water. The results of these analyses are summarized in the Annual Environmental Monitoring Report prepared by BPS for SPR-PMO. The sampling locations are identified with the letters on Figure 3-4. Point D in Blue Lake and Point J in Mud Lake are located away from the shore and are representative of conditions in the lake, while the other sampling points, which are located along the shore, monitor the effects of site runoff. Samples are usually taken monthly, unless low water levels make it impractical to collect a sample. Parameters measured include pH, alkalinity, salinity, temperature, dissolved oxygen (DO), total organic carbon (TOC), chemical oxygen demand (COD), nitrite, nitrate, orthophosphate, total iron, calcium, and magnesium. The analytical results presented in the Annual Environmental Monitoring Report for CY 1986 do not indicate an adverse effect on these water bodies from site operations.

Bryan Mound has also sampled and analyzed the intake water from the Brazos River Diversion Channel for temperature, pH, salinity, conductivity, COD, oil and grease (O&G), TOC, TSS, and TDS. This monitoring program was discontinued in 1986 when cavern leaching was completed and the use of raw intake water was greatly reduced.

3.1.2.4 Findings and Observations

3.1.2.4.1 Category I

None.

3.1.2.4.2 Category II

None.

3.1.2.4.3 Category III

1. Potential Oxygen Depletion of Nearby Surface Water From the Discharge of Aqueous Film Forming Foam (AFFF). AFFF is used throughout the SPR because it is effective in covering and thus extinguishing hydrocarbon liquid-based fires. The release of untreated AFFF into surface waters can have an adverse impact on surrounding wetlands. Although the materials available at the SPR sites will vary slightly in composition, they are characteristically classified

by the manufacturers as being biodegradable and practically nontoxic, having an LD₅₀ of greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered.) These materials also contain fluorocarbon surfactants (5 percent or less) that are not biodegradable. AFFF materials exhibit varying degrees of aquatic toxicity and have a high biochemical oxygen demand (BOD) and chemical oxygen demand (COD). Therefore, AFFF, if discharged to adjacent surface water, could result in temporary oxygen depletion in those waters in addition to being toxic to some aquatic species. Although there is no restriction on its use in emergency situations, state regulatory agencies require that it be treated prior to discharge when used in training or performance tests. This creates a disposal problem. Under optimum conditions, sewage treatment plants of the types installed at the SPR sites can effectively treat waste AFFF material; however, 26,274 gallons of waste AFFF are expected to be generated annually during training exercises and performance tests at Bryan Mound. The treatment plant could handle only an estimated 1,217 gallons per year. Subsequent to the on-site portion of the Survey, permission was received from the state to dispose of AFFF as an oilfield waste into Class II injection wells (Mulligan, 1988). However, Bryan Mound does not have containment facilities in place to capture and retain the entire volume of material that would be discharged in training and testing exercises. The installation of containment is being done under Project No. BM-M-136 with completion expected early in 1989. The use of AFFF for training and performance testing purposes has been temporarily curtailed until the waste disposal issue is adequately addressed.

2. Leaking Cavern Pads Could Release Contamination Into the Environment in the Event of a Spill of Brine or Oil. The cavern wellpads are diked to contain any oil or brine spills at the wells and prevent them from entering adjacent surface waters. Storm water that collects within these diked areas is analyzed for salinity and oil and grease before it is discharged so that appropriate action can be taken, if necessary. A portion of Cavern Pad 113 has been built on fill material in Mud Lake. SPR has determined through dye tests that storm water on the pad has leaked into the lake. Such leakage has defeated the purpose of the dike and has bypassed the permitted discharge point. A synthetic liner has been installed to stop the leak while a study is being made to develop a permanent solution. At the time of the on-site Survey, Cavern Pad 108, built on top of a portion of the former City of Freeport landfill, was also suspected of leaking, but this had not yet been verified by the site. Past observations by site environmental personnel, following storm events, had led them to suspect that this cavern loses water through exfiltration. Unlike Cavern Pads 113 and 108, all other cavern pads at the site were built on consolidated (solid) ground and appear to be sound.

3.1.2.4.4 Category IV

1. Brine (Disposal) Line Integrity Testing Is Not Being Performed per NPDES Permit Requirements.
The NPDES permit stipulates that the brine discharge line be hydrostatically tested for leakage every 6 months. This is not being done because it is not feasible to close all the brine line diffusers positioned in the Gulf of Mexico. Closure is necessary each time to properly perform the test. An alternate method of integrity testing is being investigated at West Hackberry and, if found acceptable to the regulating agency, will be applied at Bryan Mound. This method involves the use of duplicate, calibrated, flow meters installed in the brine line before it leaves the site and also in the first diffuser port in the Gulf. Information on the alternate method of integrity testing has been forwarded to EPA, and SPR is awaiting a reply.

3.1.3 Groundwater/Soil

3.1.3.1 Background Environmental Information

The topographic relief at Bryan Mound is 19.5 feet above the surrounding marshes. Old maps indicate that at one time a relief of 24 feet or more may have been present over the dome. Reworking of the surface during sulfur and brine operations and subsidence due to sulfur mining have altered the topography. Both Blue Lake and Mud Lake occupy areas where subsidence occurred (Hogan, 1980).

The surficial soils in the vicinity of Bryan Mound are classified by the Soils Conservation Service (SCS) as Surfside-Valesco soil, which is clayey, poorly drained or very poorly drained, very slowly permeable soils on flood plains. Alluvium of Quaternary age is underlain by clays of the Beaumont Formation. The Beaumont is the Texas equivalent of the Prairie Formation in Louisiana and is of Pleistocene age. Both the surficial sediments and the Beaumont clay have been reworked by natural soil-forming processes. At Bryan Mound itself, due to past activities, much of the surficial material is industrial rather than natural in origin. Site-specific information is limited to boreholes drilled at the locations of the crude-oil surge tanks and the raw water intake structure prior to construction of these facilities.

Depth to groundwater, measured in the geotechnical borings at the tank and intake structure locations, ranged from 4.3 to 12.5 feet. Shallow groundwater is present at Bryan Mound, but flow rates and direction would depend on the extent of horizontal and vertical interconnections between sandier layers within the clays. These shallow water-bearing zones are not used for water supplies.

The upper unit of the Chicot aquifer is the most widespread freshwater aquifer in Brazoria County and is composed of sedimentary deposits of Pleistocene age. The Upper Chicot is the only freshwater aquifer in much of the southern part of the county. It is pumped extensively in the Freeport area, which is 3 miles northeast of the site. Water-level data are unavailable, but the artificial gradient created by pumping at Freeport may cause the water supply wells in the Freeport area to be downgradient of the Bryan Mound site.

Most of the water wells in the vicinity of Bryan Mound are industrial water supply wells that are approximately 250 feet (75 meters) deep and are drilled into the Upper Chicot aquifer. The chemical quality of the water varies with location. Available analyses for nearby wells indicate the presence of slightly saline water with total dissolved solids in the range of 1,000 to 3,000 mg/L. SPR well histories (drilling and logging narratives) indicate zones of "fresh, slightly saline, and saline" water directly on

top of the mound. These zones are delineated on the basis of conductivity logs rather than by sampling and testing (Hogan, 1980).

3.1.3.2 General Description of Pollution Sources/Controls

3.1.3.2.1 Inactive Municipal Landfill

The City of Freeport operated a municipal landfill on the Bryan Mound site prior to DOE acquisition. The disposal of industrial waste into the landfill was strictly prohibited by the city. However, municipal landfills typically receive some pesticides, paints, solvents, and similar materials as residential wastes (IE, 1987; Brown and Donnelly, 1988). Surface-water infiltration, as well as storm-water drainage from suspected leakage of the Cavern 108 wellpad that partially overlies the landfill, could contribute to leachate generation in the landfill, which in turn could ultimately contaminate groundwater.

Existing knowledge is inadequate to determine whether or not this inactive landfill is a source of groundwater contamination. The only information available on the hydrogeology of the site is of a regional nature. No data have been obtained on the quality of the groundwater or the site-specific geology and hydrogeology at the landfill. A site inspection conducted by an EPA contractor in 1983 estimated depth to groundwater at the landfill at 10-15 feet and stated that a natural clay bottom was present. This information is unconfirmed because of the absence of any subsurface investigations.

Existing data from surface water sampling in Mud Lake do not address the question of potential groundwater contamination. Only gross contamination would be detected by this routine sampling because of the effect of dilution on the parameters measured (pH, alkalinity, salinity, temperature, dissolved oxygen, total organic carbon, chemical oxygen demand, nitrite, nitrate, orthophosphate, total iron, calcium, magnesium) and because the surface water may recharge groundwater for at least part of the time, rather than groundwater discharging to surface water.

Sampling and analysis of the landfill conducted as part of the CERCLA Phase I investigation considered only asbestos and priority pollutant contamination in two samples from the surface layer of the landfill (4-5 inches in depth). No asbestos was found, but several inorganic contaminants were detected (see Section 3.2.5.2.5). While the landfill is not considered a regulatory issue at this time, the potential for environmental degradation is present.

3.1.3.2.2 Brine Pond

Leakage from the brine pond at Bryan Mound is a potential source of groundwater contamination. Leakage is possible because the concrete surface layer is cracked, and damage to the underlying liner is suspected. The Hypalon® liner is intended to provide pond integrity. However, similar liners at other SPR sites are known to leak despite repeated repairs. There is no leak detection system such as an underdrain, although such a system was in use prior to expansion of the pond (as-built drawings for brine pond modifications are dated 1982). A single monitoring well (P1) (see Figure 3-4) at the brine pond has high salinity (80-100 parts per thousand), a fact which could indicate groundwater degradation due to the separate or combined effects of pond leakage, prior (non-DOE) brine operations in the area, and natural saltwater intrusion from the Gulf of Mexico. Sea water is approximately 35 parts per thousand, so that such saltwater intrusion could account for only part of the observed salinity.

3.1.3.2.3 Cavern Wells and Boreholes

Five existing caverns previously used by Dow Chemical Company for brine production were acquired by DOE in 1977. Four of these (Caverns 1, 2, 4 and 5) are currently used for crude oil storage. The remaining cavern (3) was unsuitable for oil storage. This cavern is located west of Caverns 2 and 4; its entry well is near the west guard building and north of the laydown yard. No decision has been made by SPR as to whether to maintain access to Cavern 3 or to plug and abandon it in accordance with Railroad Commission of Texas Statewide Rule 14 (Mills, 1988). One of the entry wells at Cavern 4 is isolated from the cavern and plugged back to the caprock. Cavern 4 is active and has three other entry wells.

An inactive borehole, known as D-9 or FSC1G, is located southwest of Wellpad 105. It was drilled into salt in 1949 to a depth of 6,173 feet (Hogan, 1980) but was never leached. The borehole is apparently used for testing of temperature-logging equipment (Mills, 1988).

During the geological site characterization for Bryan Mound (Hogan, 1980), attempts were made to document all known wells. Recorded oil and gas wells, including D-9, as well as map locations for sulfur exploration wells, are presented in the site characterization document. It is probable that many other holes were drilled for which no records exist, and that casings were pulled and the holes allowed to collapse. Thus, conduits for groundwater contamination probably exist, but it is no longer possible to identify or to properly plug such penetrations. Groundwater degradation can potentially occur by contaminant migration between aquifers, but the extent of such degradation cannot be evaluated because of the absence of baseline data prior to past exploratory drilling. As

discussed in Section 3.1.3.1, groundwater from water wells in the vicinity of Bryan Mound is known to be slightly saline. These wells are approximately 250 feet (75 meters) deep, and it would be difficult to distinguish the effects of salt migration upwards through collapsed boreholes from saltwater intrusion from the Gulf of Mexico.

Where well casings still exist, wells were observed by the Survey team to be plugged at the surface. Further plugging and abandonment plans by the SPR will be developed as decisions are made to abandon cavern wells and boreholes.

3.1.3.2.4 Tarry Areas

Several areas in which surface soil is contaminated by a solidified tarry substance exist at Bryan Mound. This substance is found in three general locations: northwest of Wellpad 110, south of Wellpad 110, and west of Wellpad 102. These areas were identified and sampled during the CERCLA investigations conducted by the site. They are discussed further in Section 3.2.5.2.3, which includes a map of their locations and relevant analytical data.

The area northwest of Wellpad 110 may be part of a larger tarry area or tar pit, which has since been backfilled. The existence of this backfilled tar pit was determined from interviews with former site personnel who had been at Bryan Mound when the pit was exposed. There are currently no surface indications of this pit, but it was in the area bordered on the north by East Levee Road, on the west by South Control Road, on the south by the Old Dow Pit (Section 3.1.3.2.5), and on the east by the Wellpad 110 access road. Small patches of solidified material found on the ground surface, such as the small tarry area sampled in the CERCLA investigation, may be the result of seeps to the surface from tar still present beneath the surface in this buried, backfilled pit. Survey-related sampling and analysis was recommended to determine whether tar is present near the surface in this larger tarry area (tar pit) and, if so, whether migration into surrounding soil has occurred.

The contaminants found in the tarry areas that were sampled during the CERCLA investigations included cyanide; polynuclear aromatic hydrocarbons (PAHs) such as anthracene, pyrene, and phenanthrene; and inorganics such as lead, nickel, and zinc. (Concentrations are given in Section 3.2.5.2.3.) The probable source of such contaminants is tar residue from crude-oil tank bottoms. Crude-oil tanks and an oil refinery were once located in the area near Wellpad 110; additional oil storage tanks and an oil-fired power plant were in the area near Wellpad 102.

Samples from the tarry areas were also analyzed for leaching potential by extraction procedure (EP) toxicity analysis. All samples were well below the EP limits, a fact which indicates minimal potential

for migration by leaching and therefore the probable absence of effects on groundwater. These tarry areas contain contaminated soil, which is likely to migrate only if surface runoff moves soil particles. Direct contact with tar or tar/soil mixtures can also occur. A Category III finding on these areas appears in Section 3.2.5.3. The SPR plans to remove the surface tarry areas in fiscal year 1989 and dispose of the contaminated material at an approved facility off-site.

3.1.3.2.5 Old Dow Pit

An inactive surface impoundment is located directly east of Wellpad 2. As described in Section 3.2.5.2.2, the impoundment formerly contained brine and was also used for the brine fraction of brine/oil mixtures and small amounts of liquid wastes.

At the time of the on-site survey, the impoundment was nearly full of solids. A dark, semi-solid layer of a tar-like substance was present about 6 inches below the surface. This tarry layer was underlain by clay. The tar may be part of the same oily waste material that is present at the surface in the tarry areas discussed above (Section 3.2.5.2.4) and that may extend throughout a larger tarry area in the shallow subsurface.

Sampling conducted as part of the CERCLA Phase-I investigation indicated cyanide and metals similar to those found at the tarry areas (analytical data are presented in Section 3.2.5.2.2). PAHs were also present, as they were in the tarry areas, but at the Dow Pit the concentrations were less than 1 ppm.

EP toxicity analysis identified no contaminants exceeding the EP limits. However, nickel and zinc, which have no EP limits, were present in the extract at concentrations of 14.3 ppm and 1.58 ppm, respectively (BPS, 1986b). These extract-concentration values may indicate that nickel and zinc can be leached from the material now present in the impoundment. Survey-related sampling and analysis has been recommended to determine if contaminant migration into surrounding soil has occurred. A Category III finding is presented in Section 3.2.5, Inactive Waste Sites and Releases.

It should be pointed out that the water remaining in the Old Dow Pit shows contaminants at low levels similar to those present in Mud Lake and in the Intracoastal Waterway (Williams, 1986). Thus, any leaching of the waste material present in this impoundment is not noticeable in surface water. This fact does not contradict the potential for contaminant migration into surrounding soil as discussed above, since the effects of contact time, dilution, and soil chemistry would differ from surface to subsurface.

3.1.3.3 Environmental Monitoring Program

Three piezometers were installed at the Bryan Mound site in 1981 by Jacobs/D'Appolonia Engineers. They are constructed of 2-inch polyvinyl chloride (PVC) pipe. Construction is adequate except for the absence of surface concrete pads.

No written procedures exist for well sampling. According to the Site Environmental Specialist, piezometers P2 and P3 near the anhydrite disposal area are evacuated, allowed to recharge, and sampled the next day. Piezometer P1 near the brine pond recharges too rapidly to be evacuated. Bailing is done for 15 minutes (time basis, not volume basis) at P1. Sampling is done either with a bailer or a peristaltic pump with Tygon tubing. The bailer is PVC (Salinas, 1987b).

A demonstration of groundwater sampling procedures at Bryan Mound was observed during the on-site Survey. Wells are sampled using a bailer, and, purge water is discharged to the ground surface. As pointed out by the Site Chemist, the salinity in purge water at P1 is high enough to kill vegetation, and thus discharging it to the ground surface is an undesirable practice. Equipment is allowed to touch the ground, a practice that could transfer surface contamination into the wells. Depths to water are estimated. Only P1 and P3 could be sampled; P2 is apparently damaged.

These wells are not sampled routinely. No sampling was done during 1987. Although no regulatory requirement exists for reporting data from piezometer sampling, such sampling is a viable way to detect variations in groundwater chemistry that could result from otherwise unobservable site conditions (e.g., brine pond leakage). Routine sampling has proven to be successful in detecting environmental problems at other SPR sites, such as the salinity increase in groundwater at West Hackberry (see Section 6.1.3).

3.1.3.4 Findings and Observations

3.1.3.4.1 Category I

None.

3.1.3.4.2 Category II

None.

3.1.3.4.3 Category III

1. Possible Groundwater Contamination from the Inactive Municipal Landfill. An inactive municipal landfill, located on the eastern edge of the Bryan Mound site between Wellpad 108 and Mud Lake, may be a possible source of groundwater contamination in the shallow aquifer beneath the site. The landfill occupies approximately 23 acres. A historical photograph taken during the active life of the landfill shows it extending from the water level of Mud Lake up to a height of approximately 15 feet.

The City of Freeport operated this landfill at two periods of time, during the 1960s and again from 1976 through 1977. The disposal of industrial waste into the landfill was prohibited by the city (BPS, 1986b). However, municipal landfills typically receive some pesticides, paints, solvents, and similar materials as residential wastes (IE, 1987; Brown and Donnelly, 1988).

Surface-water infiltration and possibly storm-water drainage from suspected leakage of the Cavern 108 wellpad that partially overlies the landfill, could contribute to generation of leachate. This leachate from the landfill could enter groundwater. However, no information on groundwater in the landfill area exists. The only available hydrogeological information is of a regional nature.

Surface-water sampling data that exists for Mud Lake does not address potential groundwater contamination. Only gross contamination of surface water would be detected because of the effect of dilution of the parameters measured, and because surface water probably recharges groundwater at least part of the time, rather than groundwater discharging to surface water.

Sampling and analysis conducted as a part of the CERCLA Phase I investigation (see Section 3.2.5.2.5) considered only asbestos and priority-pollutant contamination in two samples from the surface layer of the landfill (4–5 inches in depth). No asbestos was found, but several inorganic contaminants were detected. The inorganics of highest concentrations included zinc (85.5 ppm and 74.4 ppm), lead (42.9 ppm and 48.6 ppm), nickel (32.8 ppm and 36.1 ppm), and chromium (26.9 ppm and 24.2 ppm). Because these are total concentrations within waste material, no regulatory limits are applicable. Extraction procedure (EP) toxicity analysis for inorganics in both samples was negative. The only organic found via EP toxicity testing was the pesticide beta-BHC at a concentration of 2.5 parts per billion (ppb). However, there is no EP toxicity limit for beta-BHC. The presence of these RCRA-listed contaminants in a municipal landfill does not create a regulatory issue. However, the potential for environmental degradation is present.

Survey-related sampling has been recommended to determine if the groundwater in the vicinity of the landfill is contaminated and if the landfill is a source of such potential contamination.

2. Possible Brine Pond Leakage to Groundwater. Possible leakage from the brine (saline solution) pond could serve as a potential source of groundwater contamination of the underlying aquifer. A monitoring well (piezometer) adjacent to the brine pond has high salinity (80-100 parts per thousand), which is indicative of groundwater degradation due to the separate or combined effects of pond leakage, prior (non-DOE related) brine operations in the area, or natural saltwater intrusion. (Sea water is approximately 35 parts per thousand; thus natural saltwater intrusion can account for only part of the observed salinity.)

The Survey team observed cracks in the pond's concrete surface and noted that expansion joint material was not secure. This concrete serves as protection to the underlying hypalon liner, which is intended to provide pond integrity. Survey-related sampling has been recommended to determine the potential for groundwater contamination from a possible brine pond leak.

3.1.3.4.4 Category IV

1. Lack of Routine Groundwater Monitoring. The lack of routine sampling of the two functioning piezometers at Bryan Mound negates the possibility of detecting groundwater degradation from site activities. Routine sampling has proven to be successful in detecting salinity increases in groundwater at the West Hackberry SPR site. Although no regulatory requirement exists for reporting data from piezometer sampling, such sampling is a viable way to detect variations in groundwater chemistry that could result from otherwise unobservable site conditions (e.g., brine pond leakage).
2. Incomplete Groundwater Sampling Procedures. No written sampling procedures for groundwater monitoring wells at Bryan Mound exist. Well purging, according to descriptions of procedures provided by site personnel, is adequate, but actual sample collection practices, demonstrated during the on-site Survey, do not adhere to procedures recommended by the EPA for hazardous waste monitoring, specifically in regard to equipment cleanliness, field measurement, and documentation; these procedures are considered appropriate for any groundwater monitoring. However, the techniques in use do not invalidate the gross salinity-type measurements being performed.

3.2 Non-Media-Specific Survey Findings and Observations

This section discusses findings and observations pertaining to waste management, toxic and chemical materials, radiation, quality assurance, and inactive waste sites and releases. These discussions do not include a background environmental information section because the areas addressed are not necessarily tied to one medium, as was the case with the discussion in Section 3.1. These discussions include an environmental monitoring program section, where appropriate and where information was available.

3.2.1 **Waste Management**

3.2.1.1 Background Information

The Bryan Mound site generates various oil-and-gas wastes, municipal solid wastes, and hazardous wastes. The site does not generate any industrial solid wastes, radioactive wastes, or radioactive/hazardous mixed wastes. Brief descriptions of these wastes are as follows:

- Oil-and-gas wastes are wastes arising out of or incidental to drilling for or producing of oil, gas, or geothermal resources; wastes arising out of or incidental to the underground storage of hydrocarbons other than storage in artificial tanks or containers; or wastes arising out of or incidental to the operation of gasoline plants, natural gas processing plants, or pressure maintenance or repressurizing plants (MOU, 1987).
- Industrial solid wastes are wastes resulting from or incidental to any process of industry or manufacturing, or mining or agricultural operations [Texas Solid Waste Act, Section 2(14)].
- Municipal solid wastes are wastes resulting from or incidental to municipal, community, commercial, institutional, and recreational activities, including garbage, rubbish, ashes, street cleanings, dead animals, abandoned automobiles, and all other solid waste other than industrial solid waste [Texas Solid Waste Act, Section 2(17)].
- Hazardous wastes are those wastes identified as such in 40 CFR 261 [i.e., regulated under the Resource Conservation and Recovery Act (RCRA)] [Texas Solid Waste Act, Section 2(13)]. Such wastes are either ignitable, reactive, corrosive or toxic, or contain materials listed in 40 CFR 261.

- Radioactive wastes are wastes containing radioactivity (i.e., materials that emit radiation, such as alpha and beta particles, neutrons, electrons, and gamma rays).
- Mixed (radioactive and hazardous) wastes are co-contaminated with radioactive and hazardous waste materials.

Most of the wastes generated at Bryan Mound are oil and gas wastes. Activities that generate these wastes are listed below (MOU, 1987). Oil and gas wastes are regulated by the Railroad Commission of Texas (RCT). Storage and disposal of most oil and gas wastes must be permitted, such as brine storage in the Bryan Mound brine pond and brine disposal into the Gulf of Mexico (Rule 8, RCT, undated). The site must also use carriers that are permitted by the State to transport such waste off-site.

Activity	Waste
Drilling, operation and plugging of wells	Drilling fluids (including water-based and oil-based fluids), cuttings, produced water (brine), produced sand (anhydrite), waste hydrocarbons (including used oil), fracturing fluids, spent acid, workover fluids, treating chemicals (including scale inhibitors, emulsion breakers, paraffin inhibitors, and surfactants), waste cement, filters, and trash (including barrels, dope cans, oily rags, mud sacks, and garbage).
Storage of Oil	Tank bottoms, storm-water runoff.
Underground hydrocarbon storage	Saltwater (brine).

Oil and gas wastes are temporarily exempted from regulation as hazardous wastes under Section 3001(b)(2)(A) of the 1980 amendments to RCRA, pending further study by EPA. After submission of study results to Congress, and public hearings and opportunity to comment, the Administrator of EPA must determine either to promulgate regulations under the hazardous waste management provisions of RCRA (Subtitle C) or to declare that such regulations are unwarranted. Because wastes arising out of or incidental to the underground storage of hydrocarbons are considered oil and gas wastes in Texas (see oil and gas waste definition above), the current exemption applies to the Bryan Mound oil and gas wastes. Exempted wastes are defined in detail in the Report to Congress, Management of Wastes from the Exploration, Development, and Production of Crude Oil, Natural Gas, and Geothermal Energy (EPA, 1987a).

Municipal solid wastes are regulated by the Texas Department of Health (TDH). Because all of these wastes generated at Bryan Mound are either disposed of or reclaimed off-site, no TDH permit is required.

Hazardous wastes are regulated by the Texas Water Commission (TWC). TWC was granted authority from EPA in December 1984 to manage the RCRA hazardous waste program in Texas. Regulations that apply to Bryan Mound as a hazardous waste generator are contained in Texas Industrial Waste Management Regulations (Texas Administrative Code, Title 31, February 1988).

The current Texas regulations would require Bryan Mound to possess an EPA hazardous waste generator identification number if the site generated more than 100 kilograms of hazardous wastes per month (Texas Industrial Waste Rules, Section 335.63). Before Texas was granted RCRA authority, EPA issued the site EPA generator number TX0890032584 in response to SPR's 1980 Part A RCRA Section 3005 notification. EPA reclassified the site to nonhandler status in June 1982 (Paul, 1982) because the site was then considered a small-quantity generator. The site generated less than 1,000 kilograms of hazardous wastes per month, and at the time, only sites generating 1,000 kilograms or more per month needed an EPA identification number. However, effective September 22, 1986, the definition of a small-quantity generator changed (51 FR 10146, March 24, 1986). Now only sites generating less than 100 kilograms per month are considered small-quantity generators. Texas subsequently revised its regulations to conform with the Federal definition, and all sites in Texas generating 100 kilograms or more per month need an EPA identification number.

3.2.1.2 General Description of Pollution Sources/Controls

3.2.1.2.1 Oil-and-Gas Wastes

Oil-and-gas wastes managed at the Bryan Mound SPR include wastes generated from the storage of crude oil in salt dome caverns, such as brine, anhydrite, tank bottoms, and spill cleanup wastes (e.g., slop oil, oil-contaminated soil, and oily sorbent pads). When the on-site portion of the Environmental Survey was conducted, all the cavern wells had been drilled, and all the caverns had been leached. Therefore, drilling muds and cuttings were no longer being generated, and only small quantities of brine and anhydrite were being generated. Previously, drilling muds, cuttings, and anhydrite were disposed of on-site, and after the wells had been drilled and the caverns had been leached, the disposal pits were closed (refer to Section 3.2.5.2). In addition, brine generated during cavern leaching was formerly disposed of into six injection wells, which were located approximately 2 miles south of Freeport. SPR plugged and abandoned these wells between November 1983 and

February 1984 (Jacobs/D'Appolonia Engineers, 1984) and now disposes of brine (generated during cavern fill and depressurization) off-shore into the Gulf of Mexico (Section 3.1.2.2.2). Anhydrite, tank bottoms, oil-contaminated soil, and oily sorbent pads are shipped via truck to the Brazoria County Disposal Corporation landfill, which is permitted to handle both oil and gas wastes and municipal solid wastes. Slop oil (i.e., small quantities of crude oil spilled or leaked during routine operations) is collected by vacuum truck and injected in the storage caverns. Oily sorbent pads are put into plastic bags and temporarily placed in a large dumpster, which is located near the pig launcher/receiver and designated to only receive this waste.

At the time of the Survey, brine was being collected in one of two brine ponds located on-site (see Figure 3-2). Both ponds were permitted by RCT in 1985 (Plt Permit No. P001447, and No. P001448; Amended). Before brine is piped offshore for disposal, oil is skimmed off the brine in the pond, and the brine is analyzed to ensure that NPDES discharge conditions are met. Anhydrite also settles and accumulates in the pond. In addition, bottoms (i.e., oily sediments from the cavern and surge tank pad oil/water separators) are collected annually and temporarily stored in the active brine pond. When solids accumulate to a certain level, the anhydrite and sediment are removed. BPS files and waste manifests indicate that the pond had been cleaned out three times prior to the Environmental Survey. For the first two cleanings, approximately 16,000 cubic yards of solids were removed and disposed of on-site in the anhydrite disposal pit. For the third cleaning, which occurred in November 1985, approximately 7,500 cubic yards of solids were removed and disposed of off-site at the Brazoria County Disposal Corporation landfill. According to site personnel, some other liquid wastes generated on site are collected, disposed of in the brine pond, and piped off-shore with the brine. These wastes are nonhazardous and include the following:

- Water used to backwash filters at the water treatment facility.
- Water from excavations (e.g., brine and pump repair work).
- Hydrostatic test waters.
- Effluents from vehicle engine cleaning.

Tank bottoms from the large surge tanks are not disposed of in the brine pond. Two of the tanks (i.e., BMT-2 and BMT-3) were cleaned out in October 1985. According to waste manifests in BPS files, approximately 27,000 barrels (1,134,000 gallons) of waste oil (crude bottoms) were removed. This oil was barged to a British petroleum facility in Gretna, Louisiana, to be used as fuel.

The active brine pond is the larger of the two ponds. It is 357 feet by 251 feet and has a volume capacity of 150,000 barrels (6.3 million gallons). It has a synthetic liner and concrete protective weight coat. Those linings were installed in the early 1980s. The pond originally had only a synthetic

liner, which became torn and leaked. The pond also had an underdrain system to collect leaking brine, but this system was removed when the original liner was replaced. At the time of the Survey, SPR did not know whether the new lining was leaking. There was no routine groundwater monitoring. SPR was primarily relying on visual inspection to detect significant seepage from the above-ground pond dikes (refer to Section 3.1.3.4.4). The Survey team observed that the concrete weight coat had many large and small cracks and that the joint compound in the concrete weight coat was coming loose.

The smaller brine pond was inactive and contained only rainwater. Its dimensions are 155 feet by 107 feet, and its volume capacity is 15,000 barrels (630,000 gallons). Like the larger pond, this pond has a synthetic liner and concrete weight coat. It was used as a surge and treatment pond during cavern leaching operations.

3.2.1.2.2 Municipal Solid Wastes

Municipal solid wastes generated at Bryan Mound include trash, used hydraulic and lubricating oils, solids from the sewage treatment plant, and dredge spoils. Trash is collected in dumpsters located at various sites and hauled off to the Brazoria County Disposal Corporation landfill by a commercial waste hauler. According to site personnel, used oils were discharged into the caverns until mid-1987, but are now to be stored on-site and then shipped off-site to be recycled. At the time of the Survey, no used oils had yet been shipped off-site. Approximately three to four 55-gallon drums of used oil are generated each month and stored adjacent to the warehouse. Lubricating oils that collect in the dispensing rack spill tray near the warehouse are taken via vacuum truck to a sump and then discharged into a cavern (approximately 10 gallons per month). Solids from the sewage treatment plant were removed once in April 1986 and disposed of on a sludge drying bed at the Oyster Creek sewage treatment plant, which is located in Oyster Creek, Texas. Dredge spoils are generated routinely when sediment in the Brazos River Diversion Channel at the raw-water-intake structure builds up and is dredged. Between 3,000 and 6,000 cubic yards of spoil are dredged annually. This spoil is disposed of in the dredge material disposal pit, which is located west of Well No. 116 near the west levee. This pit is designed to contain 25,000 cubic yards of spoil and contained between 6,000 and 9,000 cubic yards at the time of the Survey. Water that accumulates in the pit is discharged into a marsh adjacent to the diversion channel. The water is sampled for NPDES pollutants before it is discharged.

3.2.1.2.3 Hazardous Wastes

Bryan Mound also generates small quantities of spent solvents (i.e., Varsol, which is a flammable petroleum distillate, and 1,1,1-trichloroethane), which are hazardous wastes, according to 40 CFR 261. Approximately 130 gallons of solvent are generated per year, or 11 gallons (40 kg) per month. Because less than 100 kilograms of hazardous wastes are generated per month, the site is not required to have a hazardous waste generator identification number or a hazardous waste storage permit. Until recently, these spent solvents were managed like used oil (i.e., disposed of into the caverns), but now they are stored until shipped off-site to be reclaimed. There had not been a shipment of spent solvent off-site prior to the on-site Survey. When the spent solvents are shipped off-site, TWC waste manifests (i.e., Texas Waste Shipping-Control Tickets) will be required, in accordance with the Texas Industrial Waste Rules, Section 335.10.

At the time of the on-site Survey, the drums of spent solvents and used oil were stored outside the warehouse on gravel. These drums are exposed to the natural elements and subject to deterioration. In addition, because the surface under the drums is not impervious and the area is not curbed, a spill could not be contained (refer to Section 3.2.2.2.3). At the time of the Survey, two drums were being used to accumulate and store the used oil and spent solvents. The drum used to store the spent solvents was not properly labeled. Hazardous waste drums should be clearly marked with the words, "Hazardous Wastes," and drum labels should indicate the date on which waste accumulation began [Texas Industrial Waste Rules, Section 335.69(a)(2)&(3)]. Neither information was provided on the drum.

Two shipments of other hazardous toxic wastes have previously been sent off-site for disposal (Little, 1986). In 1981, 56 drums of PCB-contaminated oils were removed from a transformer and sent to the Chemical Waste Management, Inc., facility in Emelle, Alabama, by Peterson Maritime Services, Inc. (refer to Section 3.2.2.1.3). In 1984, 275 gallons of hydrochloric acid, which was left over from acidification of Cavern 4, were sent to the Chemical Waste Management, Inc., facility in Port Arthur, Texas, by Peterson Maritime Services, Inc.

The analytical laboratory at Bryan Mound uses hazardous substances, but they are either consumed, recycled, or disposed of down the laboratory sinks in very small quantities. The laboratory sinks are connected to the site's sewage treatment plant. A freon solvent is used, and the portion that does not evaporate is recycled for reuse in the laboratory. Alcohols are used as reagents, and acids are used to clean glassware and to preserve samples. Freon distillation bottoms and paper wipes with solvents are disposed of with trash. According to site personnel, chemicals rarely become outdated so as to require disposal.

3.2.1.2.4 Underground Storage Tanks

There are two underground storage tanks at the Bryan Mound SPR facility. Both are crude oil sumps. Sump 30, also referred to as BMT-5, has a 1,000-gallon volume capacity, and collects oil by gravity flow from the high-pressure pump pad, the meter prover station, and the pig launcher/receiver. In addition, oil from cavern cellars is collected by vacuum truck and disposed of in this sump. Oil in the sump is injected into a cavern or pumped into an aboveground tank for storage. Sump 62, also designated BMT-6, has a 6,000-gallon capacity and was out of service at the time of the Survey. Previously it received oil from the oil/brine separators. This oil also was either injected into a cavern or pumped into an aboveground tank. Both of the USTs are made of fiberglass-reinforced plastic, and both were less than 8 years old at the time of the Survey. Although SPR did not have a leak detection program for USTs, the potential for UST leakage appeared to be low and did not present a significant environmental risk. Both tanks were reported to the TWC pursuant to RCRA Subtitle I requirements (Teerling, 1986b).

3.2.1.3 Findings and Observations

3.2.1.3.1 Category I

None.

3.2.1.3.2 Category II

None.

3.2.1.3.3 Category III

None.

3.2.1.3.4 Category IV

1. Noncompliance with Hazardous Waste Regulations. Bryan Mound generates two spent solvents that are hazardous wastes. However, the drum used to store the wastes was not properly labeled, and therefore, the site is in violation of the Texas Industrial Waste Rule, Section 335.69. Waste drums should be clearly marked with the words, "Hazardous Waste," and drum labels should indicate the date on which waste accumulation began [Texas

Industrial Waste Rules, Section 335.69(a)(2)&(3)]. Neither piece of information was provided on the drum.

According to site personnel, approximately 130 gallons of spent Varsol and spent 1,1,1-trichloroethane are generated per year. Varsol is a flammable petroleum distillate. Because this product has a flash point of less than 140°F, it has a hazardous characteristic of ignitability (EPA Hazardous Waste Number D001; 40 CFR 261.21). The solvent 1,1,1-trichloroethane is a RCRA-listed waste (EPA Hazardous Waste Number F001). Volumes generated are equivalent to 40 kilograms per month. Because less than 100 kilograms of hazardous waste are generated per month, the site is not required to possess an EPA hazardous waste generator identification number pursuant to Texas Industrial Waste Rules, Section 335.63.

3.2.2 Toxic and Chemical Materials

3.2.2.1 General Description of Pollution Sources/Controls

3.2.2.1.1 Toxics Management

The control of toxic and chemical materials at Bryan Mound is the combined responsibility of the Purchasing, Quality, Safety, and Environmental Departments. Some procedures governing the purchase of such materials have been established. The Environmental Department has notified the Purchasing Department that all purchase requisitions for any chemical must be reviewed and approved by the Environmental Department prior to purchase of the product (Salinas, 1985). The supplier must also provide a copy of the current Material Safety Data Sheet (MSDS) for the product with all shipments (Salinas, 1987c). The Environmental Department can reject the purchase or use of a particular hazardous material at Bryan Mound due to potential environmental or occupational health concerns. An inventory of all toxic and chemical materials in use at Bryan Mound was being compiled by the site at the time of the Environmental Survey.

All materials purchased by Bryan Mound, including toxic and chemical materials, are delivered to the Central Receiving Department. After these shipments have been inspected and the amounts and types of materials received verified, the materials are distributed to one of three locations known as Storage Areas A, B, and C (Figure 3-5). Storage Area A is a building that also serves as the Central Receiving Department offices. No toxic or chemical materials other than 5-gallon containers of herbicides are stored in Storage Area A, and no deficiencies regarding the storage of these herbicides was noted during the Environmental Survey. Storage Area B is out-of-doors, but no toxic or chemical materials are stored at this location. Storage Area C (also known as the Laydown Yard) is the primary location for the storage of toxic and chemical materials. Storage Area C is out-of-doors, and 55-gallon drums and other containers of toxic and chemical materials are stored on drum racks or wooden pallets placed on the ground. At the time of the Environmental Survey, approximately two hundred 55-gallon drums of AFFF, 10 drums of various oils, 2 drums of solvents, and about 20 gallons of paint were stored in Storage Area C. This area is not protected from adverse weather conditions (i.e., lacks a roof and walls), and impervious flooring or curbing has not been provided to contain potential spills. Storage Area C is also located in an area susceptible to flooding as a result of severe storm surges. Therefore, in the event of a drum leak or rupture, spilled substances would contaminate surrounding soils and could be released into nearby surface waters. The storage of toxic and chemical materials at locations lacking effective spill control measures has previously been

FIGURE 3-5

TOXIC AND CHEMICAL MATERIALS STORAGE AREAS AT BRYAN MOUND STRATEGIC PETROLEUM RESERVE

identified during environmental audits of Bryan Mound conducted by the operating contractor (Teerling, 1987c), as well as during an EPA inspection of the Weeks Island site (Townsend, 1986) and a DOE-PMO Site Management Appraisal at the St. James Marine Terminal (Wagoner, 1987). Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous waste) drum storage areas, such measures are considered good management/operational practice. A request to install covered drum storage racks at all SPR sites was submitted to DOE by BPS but was not authorized (Teerling, 1987d). BPS has indicated that it is in the process of submitting similar requests to DOE to construct such facilities on a site-specific basis.

Bryan Mound relies upon safety data sheets and the labels placed upon containers of toxic and chemical materials by the manufacturer to inform workers of the potential hazards associated with these materials. The site regularly inspects containers of toxic and chemical materials to determine if the manufacturers' labels are present. BPS has also established formal procedures to comply with the requirements of the OSHA Hazard Communication Standard and similar requirements imposed by Texas and Louisiana (BPS, 1987b).

3.2.2.1.2 Tank Farm Facilities

Underground Storage Tanks

There are two underground storage tanks at the Bryan Mound SPR facility. Both are crude oil sumps and neither is used to store wastes. For a complete discussion of the USTs at Bryan Mound, see Section 3.2.1.2.4.

Above-Ground Storage Tanks

Four above-ground storage tanks, commonly referred to as surge tanks, each with a capacity of 8.4 million gallons, are used to store crude oil at Bryan Mound. These four tanks are surrounded by a containment dike with divider dikes between each tank. In the event of a spill (i.e., overflow, tank rupture, etc.), the secondary containment system is constructed with a capacity sufficient to contain the contents of one tank with freeboard for storm water (BPS, 1986a).

In addition to the four 8.4-million-gallon-capacity crude oil tanks, several other above-ground tanks are used for the storage of petroleum products. These include

- Two above ground tanks for the storage of gasoline and diesel at the Bryan Mound Fuel Station. These 10,000-gallon gasoline and diesel tanks are surrounded by dikes.
- Three tanks (50- to 100-gallon capacity) in the "contractor area" adjacent to Well No. 105. These tanks, which are used to store gasoline, diesel fuel, and oil, are surrounded by earthen dikes.
- One 250-gallon diesel tank at the raw-water-intake structure (no secondary containment dike).

3.2.2.1.3 Spill Prevention, Control, and Countermeasures (SPCC) Plan

The Bryan Mound site handles large volumes of crude oil and is located close to navigable waters. As a result, the requirements of the EPA Oil Pollution Prevention regulations (40 CFR 112) are particularly applicable to the site. In response to these requirements, Bryan Mound has prepared and implemented an SPCC Plan (BPS, 1986a) and a Spill Contingency Plan (BPS, 1987c). These documents contain listings of potential spill sources; type and quantity of material that would be released; personnel and equipment resources; and spill evaluation, support, and response procedures.

Engineering controls have also been implemented at the site. Containment dikes that drain to sumps equipped with oil/water separators have been constructed at each cavern wellpad. Concrete curbing has been installed at the high-pressure pump pad to divert small spills into an oil/water separator. Spills onto the concrete pad at the meter prover station would also drain to this separator. At the pig trap, a drain line connects the sump beneath the pig trap door to a larger, 1,000-gallon-capacity sump.

An Emergency Response Team (ERT) has been established at Bryan Mound. All ERT members receive 40 hours of training at the ERT Academy at Lamar University (BPS, 1987d). At least two members of the ERT team have also attended an additional 40-hour course on oil spill control and cleanup at Texas A&M University, Galveston. An inventory of spill control equipment is maintained at the site.

Formal monthly inspections of the site for deficiencies related to spill prevention and control are performed by the Bryan Mound Environmental Specialist (BPS, 1986a). The inspection report is

forwarded to the Bryan Mound Site Manager for review and approval. SPR has established formal reporting requirements for oil spills of one or more barrels, or oil spills of any quantity on navigable waterways. Similar reports must be prepared for brine spills of any quantity leaving the site or five or more barrels on-site. For spills of hazardous substances, the reporting requirements established by EPA have been implemented. During CY 1986, two reportable oil spills and two reportable brine spills occurred at Bryan Mound (Teerling, 1987e). All were contained on-site.

3.2.2.1.4 Polychlorinated Biphenyls (PCBs)

It is the policy of SPR not to permit any equipment that is known to contain fluids with a PCB concentration in excess of 5 parts per million (ppm) on any SPR site (BPS, 1987e). Most of the oil-filled electrical equipment at Bryan Mound has been tested for PCB content.

Three transformers are currently in use at the Bryan Mound electrical substation. When the oil in these three transformers was tested in 1982, no detectable levels of PCBs were found (Moon, 1982). Therefore, the transformers at the electrical substation are classified as non-PCB transformers. In addition to the non-PCB transformers at the electrical substation, there are two oil-filled, pole-mounted transformers at Bryan Mound. These two transformers have not been tested for PCB content. In accordance with the EPA PCB regulations, these two transformers have been classified as PCB-contaminated transformers until such time that it is practical to remove these transformers from service and test them for PCB content (Teerling, 1985).

One oil-filled circuit breaker is also present at Bryan Mound. Testing of the fluid in this circuit breaker indicated that it did not contain PCBs (Yarotsky, 1984).

No PCB-containing capacitors are known to be present at Bryan Mound.

Three transformers other than those described above were used during the construction of the Bryan Mound site (Luckianow, 1981a). When work on the Bryan Mound electrical substation was completed, these three transformers were taken out of service and stored in the Laydown Yard. When these three transformers were subsequently tested for PCB content in 1981, one of the transformers was found to contain 120 ppm PCBs; the other two transformers contained less than 10 ppm PCBs. In December 1981, a contractor was retained to remove the oil contaminated with PCBs from the one transformer and dispose of the wastes. As a result of this activity, 56 drums of waste PCBs were disposed at the Chemical Waste Management site in Emelle, Alabama (Luckianow, 1981b,c,d).

3.2.2.1.5 Pesticides

Pesticides (i.e., insecticides, herbicides, and rodenticides) are used at Bryan Mound and are applied only by site personnel (Salinas, 1987d). Roundup and Karmex are herbicides that are used for weed control on perimeter fencing and cable trays. Dursban, Diazinon and Malathion are used for fire ant or mosquito control. No restricted-use pesticides (i.e., pesticides that according to EPA may be applied only by a certified pesticide applicator or persons directly supervised by a certified pesticide applicator) are used at Bryan Mound (Teerling, 1987f).

Procedures have been established by Bryan Mound only for the use of insecticides to control mosquitoes (Salinas, 1987e). Records of pesticide applications to control mosquitoes are maintained by Utility Department personnel. On the average, 15 to 25 gallons of insecticides are used each time spraying is performed to control mosquitoes, a process that occurs approximately 15 times each year (Bolling, 1987). Procedures governing the use of other pesticides at Bryan Mound have not been established, as these are unrestricted-use retail products. Site personnel indicated that pesticides are applied in accordance with the directions on the pesticide container labels. Application records for pesticides used to control pests other than mosquitoes are not maintained.

The supply of the pesticides used at Bryan Mound is stored in a small, locked building near the Utility Department offices and at Storage Area A. These locations were inspected during the Environmental Survey and were found to be in an orderly condition, with no evidence of leaks or spills. Any mixing of pesticides performed prior to application is conducted in the Utility Department office area.

In addition to the herbicides that are applied by site personnel at Bryan Mound, a pipeline crew stationed in Bryan Mound is responsible for spraying herbicides at road crossings and valve stations on both the Bryan Mound crude oil pipeline to/from the Arco terminal and the brine discharge line. A commercial aerial spraying contractor is also used to spray herbicides (Tordon K and Esteron 99) along the entire length of these pipelines. This contractor meets all the requirements for aerial herbicide spraying mandated by the Texas Department of Agriculture (Whitmire, 1987).

3.2.2.1.6 Asbestos

SPR began operations in the late 1970s. As a result, the various SPR sites, including Bryan Mound, were constructed using relatively little asbestos-containing materials. However, two buildings at Bryan Mound were covered with asbestos siding when DOE acquired the facilities. One of these asbestos siding buildings was demolished in 1986, while the other was scheduled for demolition

shortly after the on-site portion of the Environmental Survey. Wastes from the 1986 demolition were disposed at the Brazoria County Disposal Corporation landfill (Salinas, 1986). This disposal facility is approved by the Texas Department of Health to accept asbestos waste (Griffith, 1986). As required by the National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart M-Asbestos, Bryan Mound has prepared a notification letter that will be provided to the local government agency responsible for enforcing the NESHAP standards (i.e., the Texas Air Control Board) prior to demolition of the second asbestos siding building at Bryan Mound (Teerling, 1987g).

Asbestos-containing gaskets are in place on the SPR pipelines. SPR has established procedures for properly removing and disposing of the asbestos-containing gaskets during routine maintenance (BPS, 1986c). These procedures will be utilized at Bryan Mound until all asbestos-containing gaskets have been properly removed, disposed, and replaced with asbestos-free gaskets.

3.2.2.1.7 Chlorofluoroalkanes

Approximately 450 pounds of chlorofluoroalkanes are used at Bryan Mound annually (Teerling, 1987h). These materials are used primarily as refrigerants in air conditioning units or to clean electrical parts. As a group, the chlorofluoroalkanes are relatively volatile compounds, and potential environmental problems due to vapor emissions can result if they are not properly handled and stored. More than 90 percent of the chlorofluoroalkanes purchased by Bryan Mound are CFC-12 or CFC-22; these materials are gases at room temperature. CFC cylinders are stored indoors at Bryan Mound at Storage Area A until needed. During the Environmental Survey, chlorofluoroalkanes appeared to be stored properly at Bryan Mound.

3.2.2.2 Findings and Observations

3.2.2.2.1 Category I

None.

3.2.2.2.2 Category II

None.

3.2.2.2.3 Category III

1. Inadequate Secondary Containment Measures. There is a potential for releases of oil and chemical materials into the environment from drum storage areas lacking effective spill containment. Drums containing chemical products are currently stored out-of-doors, unprotected from adverse weather conditions at locations lacking impervious flooring and curbing to contain spills. In the event of a drum leak or rupture, spilled substances would contaminate surrounding soils and could possibly be released into nearby surface waters. This deficiency was previously identified during a BPS environmental audit of the Bryan Mound site. In addition, the lack of proper storage areas for toxic and chemical materials was noted during an EPA inspection of Weeks Island, another SPR site, and a DOE Site Management Appraisal at the St. James Marine Terminal. Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous waste) drum storage areas, such measures are considered good management/operational practice.

Examples of deficient storage of chemical products noted by the Environmental Survey team at Bryan Mound include the following:

- Unprotected storage of paints, solvents, AFFF, and oils in an area of the site (Storage Area C or the Laydown Yard) that is susceptible to flooding as a result of severe storm surges. (About two hundred 55-gallon drums of AFFF, 10 drums of various oils, 2 drums of solvents, and 20 gallons of various paints.)
- A 250-gallon above-ground storage tank, containing diesel fuel, that is located at the raw-water-intake structure. This storage tank is not diked.

3.2.2.2.4 Category IV

None.

3.2.3 Radiation

3.2.3.1 Background Information

Radioactive materials are used at the SPR sites only in the form of sealed sources. Sealed sources are not likely to present an environmental risk unless they are improperly used or develop undetected leaks. The use of radioactive materials in Texas is regulated by the State of Texas Department of Health under the Texas Radiation Control Act.

The Texas Regulations for the Control of Radiation allow, without the need for a specific license, the possession and use of radioactive materials in devices designed and manufactured for the purpose of detecting, measuring, gauging, or controlling thickness, density, level, interface, location, radiation, leakage, or qualitative or quantitative chemical composition, or for producing light or an ionized atmosphere. The radioactive materials used at the SPR sites are in this category. These regulations require that sealed sources be affixed with labels containing appropriate warnings and precautions and that they be tested for leakage at no longer than 6-month intervals, or at such other intervals as are specified by the manufacturer. Devices containing only tritium or not more than 100 microcuries of other beta- and/or gamma-emitting material or 10 microcuries of alpha-emitting materials and devices held in storage in the original shipping containers prior to initial installation need not be tested for any purpose. The regulations further state that records of tests for leakage of radioactive material be maintained until the source is transferred or disposed.

Radiography and well-logging operations are provided to the SPR by contractors. The contractors hold the licenses for the possession and use of sources needed for these activities and are responsible for applicable radiological safety. Texas Regulations for the Control of Radiation require that, in the event that a well-logging source cannot be retrieved, a permanent identification plaque must be mounted at the surface of the well. The plaque must contain: (1) the word "caution," (2) a radiation symbol, (3) the date the source was abandoned, (4) the name of the well operator and owner, (5) the well name and well identification number, (6) an identification of the sealed sources by radionuclide and quantity of activity, (7) the depth of the source, and (8) an appropriate warning.

3.2.3.2 General Description of Pollution Sources/Controls

There are 57 gamma-ray densitometers at the Bryan Mound site. The activities of these sources range between 100 and 4,000 milliCuries (mCi) of cesium-137. The sources are required to be leak tested once every three years. The most recent leak test was conducted in May 1986. No leaks were

detected. The Survey team examined the mounting of selected units on brine lines and found them to be secure.

There is one sulfur analyzer that uses an Iron-55 source as a source of x-rays. This source is required to be leak tested every 6 months. The last leak test was in November 1987. No leaks were detected.

No gamma-ray well logging sources have been lost on-site.

3.2.3.3 Findings and Observations

3.2.3.3.1 Category I

None.

3.2.3.3.2 Category II

None.

3.2.3.3.3 Category III

None.

3.2.3.3.4 Category IV

None.

3.2.4 Quality Assurance

3.2.4.1 General Description of Data Handling Procedures

The quality assurance (QA) aspects of the environmental monitoring programs at all of the SPR sites are governed by quality assurance procedures developed by BPS (Teerling, 1986c). The QA requirements are based on the EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories (EPA, 1979). The EPA handbook addresses quality control practices associated with important aspects of analytical laboratory operations. The Environmental Survey team reviewed the BPS quality assurance program description in the Environmental Program and Procedures Manual (EPPM) (Teerling, 1986c) and found that it addresses the same topics as the EPA manual with the exception that the EPPM does not include or require procedures for sample collection.

The environmental monitoring programs at the SPR are implemented by the site Environmental Specialists, Site Field Chemists, and Site Chemical Analysts (Brv. Mound and West Hackberry Laboratories only). The Site Environmental Specialists and the Site Field Chemists all have technical degrees. In general, either the Site Environmental Specialist or the Field Chemist is responsible for collecting samples, although operations personnel collect samples on weekends. Operations personnel are permitted to conduct limited analyses (pH, salinity, and residual chlorine) on weekends. All other analyses are the responsibility of the Site Field Chemists and Chemical Analysts. The operations personnel receive training in sample collection, sample preservation, and analytical methods for salinity, pH, and residual chlorine. This training is documented.

The EPPM includes specifications and calibrations for instrumentation. The calibration requirements include frequency, types of calibrations, and corrective actions to be taken, should a calibration check fail to meet acceptance criteria. Calibrations data are recorded in the individual laboratory's bound calibration logbooks and sample logbooks.

All original laboratory data are recorded in bound notebooks. The laboratories maintain logbooks for standards/reagent preparation, calibrations and certifications, sample collection, and laboratory analysis. Entries are required to be in ink. Entries are not permitted to be data transferred from other sources (e.g., loose notes, note pads, etc.) except for field or sampling data. Transfers of field and sampling data are accepted because adverse weather may make it impractical to take the bound logbook into the field. Corrections are required to be initialed and crossed-through in such a way that the original entry remains legible. Each page is signed and dated by the analyst on a daily basis.

Samples remain in the custody of the sampler until they are delivered to the laboratory. The samples are stored in an access-restricted, secured area. Transfers of sample possession from SPR personnel to non-SPR personnel are documented using chain-of-custody forms. These forms are required to accompany all sample containers until the analyses are complete and the samples destroyed.

Laboratory analyses are based on procedures approved by the EPA. Procedures for all analyses have been selected from one of four sources:

- American Public Health Association, et al., "Standard Methods for the Examination of Water and Wastewater," 15th edition, 1981.
- American Society for Testing and Materials, "Annual Book of Standards, Part 31, Water," 1980.
- U.S. Environmental Protection Agency, "Methods for Chemical Analysis of Water and Waste," Document No. EPA-600/4-79-020, March 1979.
- U.S. Environmental Protection Agency, "Microbiological Methods for Monitoring the Environment: Water and Waste," Document No. EPA-600/8-78-017, December 1978.

The specific procedure used in a given analysis is noted in the laboratory notebook, along with an explanation of any deviations from the procedure used. Standards and reagents are purchased or prepared in conformance to the requirements of the procedures.

With each batch of analyses, one standard and one reagent blank are included. The concentration of the standard is chosen to approximate the concentration of the analyte expected in the samples. The reagent blank consists of distilled or deionized water.

Quality control samples for the determination of precision and accuracy are included with each batch of samples and constitute at least 10 percent of all samples analyzed. The control samples are prepared by obtaining samples in duplicate. Each of these is divided into two portions or subsamples. One set of subsamples is analyzed in duplicate for determination of precision. One subsample from the other set is spiked with a known quantity of analyte (this is known as a matrix spike) for determination of accuracy, and the other subsample is subjected to routine analysis.

The results of the duplicate analyses are used to evaluate analytical precision using an internal EPA methodology (Teerling, 1986c). This methodology involves the calculation of the precision

percentage for the duplicate analyses and comparison of this value with the historical average precision for the analytical technique being used. The comparison is accomplished by calculation of a parameter called the standard deviation variation (SDV). If the precision observed for a set of duplicates exactly equals the historical precision of the technique, the SDV equals zero. A positive SDV indicates precision better than the historical average, and a negative SDV indicates precision poorer than the historical average. SDV values should be randomly distributed about zero. Acceptance criteria for the duplicate analyses are SDVs of ± 1.5 (warning limit) and ± 2.0 (control limit).

An additional evaluation criterion is examination of the SDVs for what is termed a "trend-seven (T-7) error." This is a situation where seven or more consecutive SDVs have the same sign. Such an occurrence is an indication that the precision is changing, since if the only factors influencing the precision were random errors, the number of positive SDVs would approximately equal the number of negative SDVs, and seven consecutive SDVs of the same sign would be of very low probability (0.016). A series of negative SDVs indicates that precision is deteriorating and a series of positive SDVs indicates that precision is improving.

When acceptance criteria are not met, action is taken to identify and correct the cause of the deviation. Such action may include a review of calculations, reanalysis of the samples (if feasible), collection of additional samples, and examinations of sample collection and analysis procedures. The corrective action investigation protocols are defined in writing (Teerling, 1986c). No corrective action is generally taken for a "T-7 error" if the SDVs are positive, since this indicates improving precision and is often explainable by the analyst gaining experience with a given technique.

The results of the spiked subsamples and standard analyses are used to determine analytical accuracy. The evaluation is based on a parameter called the accuracy percentage, which is calculated by dividing the measured concentration of a spike by its known concentration. The acceptability of the accuracy percentage for a set of samples is determined by comparing the calculated value with the historical-average accuracy percentage and the standard deviation of the average. The acceptance criterion for analytical accuracy is that the accuracy percentage for a set of samples must be within ± 3 standard deviations of the average accuracy percentage. If these limits are exceeded, the accuracy is considered to be unacceptable, and corrective action is required. Warning limits have been established at both ± 1.5 and 2.0 standard deviations from the average accuracy percentage.

The SPR laboratories participate annually in EPA's Discharge Monitoring Report (DMR) Quality Assurance Program. This program involves the submission of samples to participating laboratories for evaluating their analytical performance. The concentrations of analytes in the samples are

known to the program administrators but are unknown ("blind") to the analysts and other SPR personnel. Samples are submitted to the SPR laboratories on an annual basis. The analytical parameters are pH, total suspended solids (TSS), oil and grease, total organic carbon (TOC), residual chlorine, and 5-day biological oxygen demand (BOD).

In addition to the EPA administered program, each SPR laboratory participates in an annual performance evaluation administered by the BPS Environmental Control Department (ECD). The ECD submits blind samples to the laboratories for analysis. The results of the analyses are evaluated by ECD personnel to check laboratory performance as part of an internal quality assurance program. The analytical parameters are the same as those used in the EPA program.

Annual audits of the SPR sites are conducted by representatives of the ECD. These audits are designed to monitor site compliance with the BPS environmental control policies and DOE Orders. As a part of the overall audits, laboratory practices and quality assurance records are reviewed.

At the Bryan Mound site, the environmental monitoring consists of discharge monitoring required by the National Pollutant Discharge Elimination System (NPDES) Permit and the Texas Water Commission's Water Discharge Permit, and surface-water monitoring in Mud Lake and Blue Lake. The surface water monitoring is not required by any regulatory agency but is being performed voluntarily by SPR to assess the impact of site operations on these bodies of water. This monitoring is further discussed in Section 3.1.2.3.

During the on-site portion of the Environmental Survey, the team toured the Bryan Mound laboratory and reviewed its quality assurance records. Laboratory practices were observed to be generally consistent with the requirements of the BPS Environmental Programs and Procedures Manual (Teerling, 1986c). A laboratory notebook was maintained for recording of all raw data and calculations. The specific procedures to be used for each of the analyses were recorded in the front of the notebook. References for all the procedures listed in the notebook, as well as the EPPM (Teerling, 1986c), were present in the laboratory for use by the analysts. The Survey team did not observe any deficiencies in the laboratory practices that would be expected to adversely affect the reliability of the monitoring data.

A review of the laboratory's internal quality assurance data for 1986 and 1987 (i.e., duplicate and spiked sample analysis) indicated that analytical accuracy and precision have met acceptance criteria (with the exception of "T-7 error") for more than 95 percent of the analyses.

For precision checks, the data frequently failed to meet the "T-7 error acceptance criteria; however, for the data reviewed, the SDV values were all positive and less than 1.0. This does not indicate a deficiency in analytical performance but an improvement in precision with respect to the historical average. Such an occurrence is common in laboratories and generally reflects improvements in technique as an analyst gains familiarity with a given analytical procedure.

The Survey team observed NPDES sampling at seven locations. All samples were obtained using a grab sampling technique. There were no deficiencies observed in the sampling techniques used. The sample containers were labeled with the sampling point and date of sampling prior to collection. The sample containers remained in the possession of the sampler or within his view at all times between the collection of the sample and its delivery to the laboratory. Upon reaching the laboratory, analysis was initiated and sample collection information recorded in the sample logbook. No sampling information was collected at the sampling point; however, this was not considered a deficiency likely to compromise the data because of the small number of samples collected and the short delay between the sample collection time (less than 30 minutes) and the return to the laboratory.

During normal working hours (Monday through Friday, 7:00 a.m. to 3:30 p.m.), samples are collected by the Field Chemist or the Site Environmentalist. Although the sampling is conducted following a set protocol, there is no written sampling protocol available.

Samples collected during periods when the neither the Field Chemist nor the Site Environmentalist is available are the responsibility of Operations. Operations personnel are trained in sampling; the addition of preservatives; and analysis for pH, salinity, and residual chlorine. The training for these personnel is documented. Laminated copies of the procedures, for those analyses performed by the operations personnel, are posted near the appropriate instruments for reference.

3.2.4.2 Findings and Observations

3.2.4.2.1 Category I

None.

3.2.4.2.2 Category II

None.

3.2.4.2.3 Category III

None.

3.2.4.2.4 Category IV

1. Lack of Written Sampling Procedures At the time of the on-site Survey, Bryan Mound did not have complete written procedures for the field collection of water samples for NPDES and surface-water quality monitoring. The Environmental Survey team observed sampling at seven NPDES sampling points and did not note any practices that would be likely to compromise the validity of the data. Personnel have received training in sample collection techniques and the training has been documented; however, there is no documentation that describes the content of the training sessions. Written sampling procedures would provide documentation that proper sampling methodologies are being used in a consistent manner by all samplers, and would help support the validity of the analytical data. In addition, the use of written procedures for training new or substitute samplers would help ensure that there will be no change in sampling methodology with a personnel change.

3.2.5 Inactive Waste Sites and Releases

3.2.5.1 Background Information

The Survey team investigated each of the SPR facilities to identify inactive waste sites and releases of hazardous materials that are sources or potential sources of environmental contamination. Inactive sites and hazardous materials releases may either be subject to various environmental regulations or may not be addressed by the environmental regulatory framework. The Survey team identified and inventoried inactive sites and hazardous materials releases that may cause environmental problems, regardless of the regulatory status of the sites or materials involved. Document reviews, personal interviews, and brief site visits are the basis for the observations and findings described in this section.

Many of the inactive waste sites and releases identified by the Survey team may be subject, via the Federal facilities provisions, to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and associated Executive Orders. Therefore, DOE Order 5480.14 (under revision) was issued on April 26, 1985, to implement DOE's CERCLA program, which intended to define actions to identify and evaluate inactive hazardous waste sites on DOE installations and to effect remedial actions, where warranted. The first two phases of a five-phase program, prescribed under DOE Order 5480.14, were completed before the Survey team visited the SPR sites. A report was prepared under each of these two phases, the Phase I CERCLA Report: Installation Assessment, April 1986 (BPS, 1986b) and the Phase II CERCLA Report: Confirmation, April 1987 (BPS, 1987f). According to DOE 5480.14, Phase I was intended to "evaluate site history and records, and to locate and identify those inactive hazardous waste disposal sites that may pose a risk to health, safety, and the environment as a result of migration of hazardous substances." Phase II was described by DOE 5480.14 as an effort to "quantify, by preliminary and comprehensive environmental survey, the presence or absence of hazardous substances that may pose a risk to health, safety, and the environment." The Survey team used the Phase I and II CERCLA Reports to aid in identifying and evaluating inactive sites and releases.

Since passage of the Superfund Amendments and Reauthorization Act (SARA) of 1986, DOE has revised its CERCLA program and DOE Order 5480.14 to implement the new SARA requirements. DOE has replaced the five-phased program and adopted the Environmental Protection Agency (EPA) program as outlined in the National Contingency Plan. DOE also issued guidance to its facilities on how to use data collected under its old CERCLA program to meet requirements of SARA. Conversion of Phase I CERCLA Reports (i.e., Installation Assessments) to Preliminary Assessments (i.e., the first step under the EPA program) was to be completed by April 1988.

This section provides an overview of inactive waste sites and releases at Bryan Mound. Relevant information was obtained from several sources, including SPR personnel and records, employees of former site tenants, and the Phase I and Phase II CERCLA reports.

3.2.5.2 General Description of Pollution Sources/Controls

Bryan Mound has several inactive waste sites. These include an inactive surface impoundment that was used for brine and oily-water disposal, several areas where tar-like deposits have been identified, an inactive municipal landfill, and an inactive mud disposal pit.

3.2.5.2.1 Past Sulfur Mining, Brining, and Industrial Activity

Bryan Mound has had a long history of industrial activity involving sulfur mining and brine production. Sulfur production began at the site in 1912. Freeport Sulphur Company (FSC) was responsible for the majority of sulfur production at Bryan Mound. To assist with sulfur production activities, FSC operated oil-fired power plants at the north and south ends of the site. Historical photographs show that there were at least three above-ground oil storage tanks adjacent to the north power plant and another located adjacent to the southern power plant. In addition, there was a small oil refinery and several storage tanks near the south end of the site where Mexican crude oil was stored and later refined on-site for various petroleum needs (e.g., gasoline). There were at least five above-ground oil tanks associated with this refinery. In 1935, American Sulphur Royalty Company obtained the sulfur production rights from FSC and intermittently produced sulfur throughout the 1960s. The Monsanto Chemical Company and Hooker Chemical Company also conducted sulfur production activities at the site. In addition to sulfur production, brining operations have also been conducted at Bryan Mound. Brining operations took place from 1942 through 1977 by Dow Chemical Company. There have been no commercial quantities of oil and gas found at this site.

The Frasch process sulfur mining that was used on the site relied on the use of superheated water that was pumped down into wells located in the sulfur formation. The sulfur melted and was pumped to the surface and stored in large vats. When the molten sulfur cooled and solidified, the sides of the vats were removed and the elemental sulfur was blasted into small pieces for wagon and rail transport. From 1912 through 1935, more than 2,000 wells were drilled at Bryan Mound for sulfur mining, resulting in the cumulative production of about 5.6 million tons of sulfur (Hogan, 1980). The Monsanto Chemical Company drilled sulfur exploration wells in 1952 but produced no sulfur. Hooker Chemical Company obtained sulfur rights in 1966 and conducted pilot

operations for about 14 months but produced relatively small amounts of sulfur. The Dow Magnesium Corporation, now the Dow Chemical Company, started brine production at Bryan Mound in 1942 and continued intermittently through 1977, when DOE purchased the land. Dow excavated five caverns, four of which are now SPR oil storage caverns.

3.2.5.2.2 Inactive Surface Impoundment (Old Dow Pit)

An inactive surface impoundment is located directly east of cavern Wellpad 2 (Figure 3-6). The dimensions of the in-ground impoundment are approximately 125 feet by 250 feet with an estimated depth of 8-10 feet. The impoundment is filled with solids to within 2 feet of ground level. Site personnel report that the impoundment is underlain by the same impermeable layer of natural clay that underlies the soil surface throughout the area. The CERCLA Phase I Report states that Dow Chemical used the impoundment for brining operations (BPS, 1986b). Site personnel refer to this inactive impoundment as the "Old Dow Pit."

This impoundment was also used during DOE operations at Bryan Mound to dispose of brine prior to 1982. This disposal included the brine fraction of brine/oil mixtures from vacuum trucks and, in some instances, the rinsewater discharged from vacuum trucks. Vacuum trucks were used routinely to vacuum brine and oil spills to transfer brine/oil mixtures and to collect oil and crude oil laboratory wastes from waste barrels on-site. The laboratory waste included oil mixed with small quantities of toluene (approximately 50 ml per sample) used in performing basic sediment and water analyses. According to Weekly Environmental Reports from 1979, under Dravo Utility Constructors, Inc., (DUCI) letterhead, this impoundment was referred to as the "liquid waste disposal pit." Several reports indicate the presence of oil in the pit. Furthermore, the report of June 18, 1979 documents the decision to use this pit to rinse out vacuum trucks and "periodically skimmer the oil off the pit and to pump it into BM Tank No. 1."

The Survey team observed a dark, thick, semi-solid layer of a tar-like substance about 6 inches below the surface of the pit. The tarry layer appeared to be about an inch thick. DOE personnel (Evans, 1987) report that this pit was constructed at the location of a former FSC Mexican-crude boiler-fuel tank from the 1920s. The tarry substance is thought to represent residual contamination from the crude-oil storage tank previously located here and which collapsed during the storm of 1932.

Recent environmental sampling and analysis by the site contractor at the Old Dow Pit has revealed the presence of several contaminants. A core sample was taken in 1984 to a depth up to 10 inches

FIGURE 3-6

LOCATION OF INACTIVE WASTE AREAS AT BRYAN MOUND STRATEGIC PETROLEUM RESERVE

TABLE 3-3

CONTAMINANTS IDENTIFIED AT THE OLD DOW PIT
BRYAN MOUND SITE⁽¹⁾
STRATEGIC PETROLEUM RESERVE

Parameter	Concentration, ppm
Cyanide	112.9
Antimony	28.7
Chromium	12.6
Copper	8.7
Lead	19.3
Mercury	2.5
Nickel	17.7
Thallium	12.8
Zinc	58.1

Source: Racal-Decca, 1984.

(1) Contaminants measured at concentrations > 1 ppm.

from the surface and analyzed for priority pollutants. Table 3-3 lists the contaminants identified at concentrations greater than 1 ppm (Racal-Decca, 1984).

The contaminant identified in the surface impoundment with the highest concentration was cyanide (112.9 ppm). Dow Chemical has stated that the presence of cyanide and the detected metals is inconsistent with their processes at the Bryan Mound facility. Freeport Sulphur Company stated that cyanides were inconsistent with their operations at Bryan Mound. Neither Dow Chemical nor FSC are aware of any on-site waste disposal during their respective periods of operation. Former Hooker Chemical employees who had worked at Bryan Mound indicated that waste disposal was limited to bleed water from the Frasch operation (Malinowski, 1984).

It is not known whether contaminants from the Old Dow Pit have been released into the subsurface soil.

At the time of the on-site Environmental Survey, the Old Dow Pit was in the process of being backfilled to grade. DOE site personnel anticipated that the pit would be fully closed (i.e., backfilled and graded) by the end of the year (1987).

3.2.5.2.3 Tarry Areas

There are several surface deposits of a thick tar-like substance at Bryan Mound. The areas appear to be generally well confined and limited to three areas of the site. The locations of these areas are shown on Figure 3-6. According to SPR personnel, it is possible that other isolated areas of tar-like deposits exist.

Two of the tarry areas are located toward the south end of the site in the general vicinity of Wellpad 110 (Areas 1 and 2, see Figure 3-6). Area 1 is located northwest of Wellpad 110; Area 2 is located south of this wellpad. The tar-like deposits at these two areas appear to be dry, weathered, asphalt-like material. The "tar" thickness ranges from less than an inch to about 12 inches. The total area of tar-like substance around Wellpad 110 is about 2,000–3,000 square feet. These tar-like substances are becoming revegetated.

Area 1 northwest of Wellpad 110 is believed to be related to a larger tarry area that was located in this vicinity. This site has been referred to variously as the "backfilled tar pit," the "abandoned tar pit," and simply, a "tar pit." The CERCLA Phase I Report included Area 1, but it could not be located during the CERCLA Phase II effort, so it was not included in the Phase II Report. Site personnel reported that the area had been covered when DOE construction activities commenced at

Bryan Mound (Salinas, 1988). According to SPR personnel, this tar pit had surface deposits similar in appearance to the other tarry areas at Bryan Mound (Salinas, 1988). The dimensions of the area of the backfilled tar pit are unknown; estimates vary up to 20 feet by 50 feet. The depth is not known. There are presently no apparent surface indications of this larger tarry area; only the smaller area northwest of Wellpad 110 remains. Sampling and analysis data from Area 1 are believed to be representative of the backfilled tar pit (Salinas, 1988). However, Survey-related sampling has been requested at the suspected location of the backfilled tar pit.

Areas 1 and 2, as well as the backfilled tar pit, are located in the general former location of an oil-refinery and five Mexican crude-oil above-ground storage tanks (capacity unknown) that were operated up until the 1930s for FSC sulfur production (Salinas, 1987f). The refinery and tanks were removed during the 1940s or 1950s. It is not known whether this tarry substance represents residual contamination from the crude-oil storage. However, it is known that an oil-storage tank (capacity unknown) collapsed in this area during a hurricane in 1932; this may be the source of at least a portion of the deposits.

The remaining tarry area (Area 3, Figure 3-6) is located west of Wellpad 102 at the north end of the site. Like the material near Wellpad 110, this deposit appears as a dry, weathered, asphalt-like material and covers an area approximately 100 square feet. The tarry deposit is about an inch thick. This area has become revegetated and is becoming undiscernible from its surroundings. The area is located in the general former location of an oil-fired power plant that was operated more than 50 years ago (1912-1935) for FSC sulfur production (Salinas, 1987f). In addition, three large (capacity unknown), above-ground tanks, in which Mexican crude oil had been stored, were also known to have been located in the region of this tarry area. The power plant and most of the storage tanks were removed from the site during the 1950s or later. The last of the storage tanks was still standing when DOE started operations at the site. About 200 barrels of tar residue were found inside this tank (Thorbecke, 1979). The tank has since been removed.

Recent environmental sampling and analysis by the site contractor of the three tarry areas has revealed the presence of several contaminants. Samples were analyzed at three locations: Area 1 located northwest of Wellpad 110, Area 2 located south of Wellpad 110, and Area 3 located west of Wellpad 102 (Figure 3-6). Samples were taken to a depth less than 12 inches from the surface. Table 3-4 lists the results of this analysis. The table lists priority pollutants identified with concentrations greater than 1 ppm. Also listed are EP toxicity data for the Area 3 tarry area. (No EP toxicity data are available for Areas 1 and 2).

TABLE 3-4

CONTAMINANTS IDENTIFIED AT THE TARRY AREAS
BRYAN MOUND SITE
STRATEGIC PETROLEUM RESERVE

Parameter	Area 1 ⁽¹⁾ (ppm)	Area 2 ⁽¹⁾ (ppm)	Area 3 EP Toxicity Mean Concentration (mg/L)	EP Toxicity Regulatory Limits (mg/L)
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ORGANICS

Anthracene	65.0			
Benzo(a)anthracene	12.1			
Benzo(a)fluoranthene	6.4			
Benzo(a)pyrene	7.1			
Chrysene	14.3			
Cyanide	24.1	107.7		
Phenanthrene	24.1			
Pyrene	48.3	2.1		
Toxaphene	4.7			

INORGANICS

Chromium	9.2			
Copper	8.2	4.6		
Lead	33.2			
Mercury		1.5		
Nickel	38.1	76.9		
Thallium	9.7			
Zinc	68.5	23.2		

EP TOXICITY CONSTITUENTS⁽²⁾

Arsenic			0.012	5
Barium			0.029	100
Cadmium			0.001	1
Chromium			0.011	5
Lead			0.013	5
Mercury			0.011	0.2

Source: Racal-Decca, 1984; BPS, 1987f.

(1) Priority pollutants identified at concentrations greater than 1 ppm.

(2) Analyses available only for Area 3 samples.

The contaminant identified in the tarry deposits with the highest concentration was cyanide (107.7 ppm, located in Area 2, which is south of Wellpad 110). Site personnel do not have an explanation for the source of cyanide. One suggestion (Salinas, 1987f) is that the source could have been Mexican crude oil that was discharged or otherwise released from the oil refinery operation that was formerly located in this vicinity (Figure 3-6). However, there is no evidence to indicate that this was indeed the case. Other priority pollutants measured at the tarry areas are present in relatively low concentrations. The EP toxicity constituents that were measured are below the regulatory thresholds.

The tarry areas represent a potential source of soil contamination. The DOE expects to remove the tarry deposits (i.e., Areas 1, 2, and 3) in fiscal year 1989. The tarry material and soil will be disposed of off-site.

3.2.5.2.4 Inactive Municipal Landfill

The City of Freeport operated a landfill that was partially located on DOE property (Figure 3-6). The landfill operated during the 1960s and from 1976 to 1977. The city prohibited the disposal of industrial wastes into the landfill, although wastes were not examined before disposal. The landfill has since been retired and has been graded and vegetated. The landfill is about 23 acres in area and is located on the east side of Bryan Mound, between Wellpad 108 and Mud Lake. The landfill is unfenced.

Hooker Chemical notified EPA in 1981, in compliance with CERCLA Section 103(c), that asbestos insulated pipe may have been disposed of at Bryan Mound. However, recent studies at the landfill have not uncovered the presence of asbestos (Racal-Decca 1984).

The potential for groundwater contamination from the landfill is discussed in Section 3.1.3.2.1.

3.2.5.2.5 Disposal of Asbestos in Caverns 4 and 5

It was reported that Dow disposed of approximately 100 pounds of asbestos in Caverns 4 and 5 (BPS, 1986c). These caverns are used as SPR storage caverns. Brine samples from Caverns 4 and 5 were collected and analyzed for asbestos. Analysis of two brine samples from Cavern 5 indicated asbestos concentrations at 26.7 and 33.8 fibers/mL. The Cavern 4 brine samples contained no detectable asbestos fibers. Background samples collected from the nearby Brazos River Diversion Channel indicated asbestos concentrations of 55.6 and 71.3 fibers/mL, which are higher than the asbestos concentrations detected in brine from Cavern 5. (The Brazos River Diversion Channel

provides raw water for cavern leaching and brine production.) If asbestos was disposed of in these caverns prior to DOE activities, it is likely that it has been washed out in leaching processes or has settled into the sumps at the bottom of the caverns.

3.2.5.2.6 Disposal of Drilling Muds

No hazardous substances were reportedly used in the drilling muds for reentry wells into existing caverns and for Wells 101A through 112B (BPS, 1986c; Huff, 1987a). Drilling muds from these wells were disposed of on-site in mud pits. The muds were solidified with Portland cement. The site was later graded and seeded.

Drilling muds for Wells 113A through 116B (except 113B and 116A) were mixed with a chromium-containing additive. Some of the chromium-containing muds were disposed of off-site as "oil field wastes." Chromium-containing muds were also disposed of on-site in a mud pit east of Wellpad 114 (Figure 3-6). This pit was excavated in a clay soil to a depth of approximately 8 feet. The bottom of the pit was compacted. When the pit was ready to be retired, the mud was stabilized with cement and later capped with a 3-foot layer of clay. The site is not vegetated. This site was recently sampled and analyzed for EP-toxicity constituents (BPS, 1987f). Table 3-5 presents the analytical data for the mud pit. No EP toxicity constituents measured exceeded the EPA regulatory threshold levels.

3.2.5.2.7 Oil and Brine Spills

The nature of SPR activities at Bryan Mound creates the potential for crude oil and brine spills. A review of Bryan Mound environmental files show minor spills of this nature. Major spills in the past include oil spills on January 1, 1981, and March 11-12, 1983. None of the oil spills at Bryan Mound have resulted in permanent or major environmental damage. Adequate spill responses and cleanup actions were reportedly taken (Section 3.2.2.1.3).

3.2.5.3 Findings and Observations

3.2.5.3.1 Category I

None.

3.2.5.3.2 Category II

None.

TABLE 3-5

EP TOXICITY DATA FOR MUD PIT
BRYAN MOUND SITE
STRATEGIC PETROLEUM RESERVE

Constituent	EP Toxicity Mean Concentration (mg/L)	EP Toxicity Regulatory Limits (mg/L)
Arsenic	0.0078	5
Barium	0.242	100
Cadmium	0.0186	1
Chromium	0.066	5
Lead	0.06	5
Mercury	0.0033	0.2
Selenium	0.002	1
Silver	0.034	5

Source: BPS, 1987f.

3.2.5.3.3 Category III

1. Inactive Surface Impoundment (Old Dow Pit). There is an inactive surface impoundment that may be a potential source of environmental contamination. The pit, also referred to as the Old Dow Pit, is located east of Wellpad 2. It measures approximately 250 feet by 125 feet and was excavated approximately 8 feet deep in clay soil. At the time of the on-site Survey, the impoundment was in the process of being backfilled with soil and graded for closure.

The Dow Chemical Company used the pit for brining operations, which took place from 1942 through 1977. The impoundment was also used later by DOE for the disposal of brine and rinse water from vacuum trucks, which collected brine/oil mixtures, oil, and liquid laboratory wastes (DUCI 1979). The Survey team observed a dark, thick, semisolid layer of a tar-like substance about 6 inches below the surface of the pit. The tarry layer appeared to be about an inch thick.

Recent environmental sampling and analysis at the Old Dow Pit has revealed the presence of several contaminants, notably cyanide (112.9 ppm). Table 3-3 lists the contaminants identified at concentrations greater than 1 ppm (Racal-Decca, 1984). The source of the cyanide is not known.

It is not known whether contaminants from the Old Dow Pit have been released into the soil beneath the pit.

Survey-related sampling and analysis has been recommended to determine the potential for soil contamination and migration.

2. Tarry Areas. There are several deposits of a thick, tar-like substance that are known to be contaminated with elevated levels of organic and inorganic materials. These deposits may be sources of subsurface soil contamination. The tarry areas appear to be generally well confined and limited to three areas at the site. The locations of these areas are denoted as Areas 1, 2, and 3 on Figure 3-6.

Two of the tarry areas (Areas 1 and 2) are located toward the south end of the site in the vicinity of Wellpad 110. Area 1 is located to the northwest of the pad, and Area 2 is to the south. The tar-like deposits appear to be dry, weathered, asphalt-like material. The tar-like substance ranges from less than 1 inch to 12 inches thick. The total area covered with the tarry

deposit is about 2,000 to 3,000 square feet. Area 1 is believed to be related to a larger tarry area, identified variously as the "abandoned or backfilled tar pit" or simply a "tar pit," that was located in the vicinity. Area 1 was included in the CERCLA Phase I Report but could not be located during the CERCLA Phase II effort and was not included in the Phase II Report. The dimensions of the area covered by the backfilled tar pit are not known; maximum estimates specify 20 feet by 50 feet. The depth of the pit is also unknown, and no estimates are available. Recent environmental data (Racal-Decca, 1984) indicate elevated concentrations of anthracene (65 ppm), cyanide (107.7 ppm), and nickel (76.9 ppm). Other contaminants at lower concentrations have been identified (see Table 3-4). The subsurface soil has not been analyzed for the presence of contaminants.

A third tarry area is located west of Wellpad 102 at the north end of the site. This deposit appears as a dry, weathered, asphalt-like material that covers approximately 100 square feet. The deposit appears to be an inch thick. EP toxicity constituents that have been measured are below regulatory thresholds (Table 3-4). These samples were collected at a depth of 12 inches or less; deeper subsurface soil has not been analyzed for the presence of contaminants.

The DOE expects to remove the tarry deposits in fiscal year 1989. The tarry material and soil will be disposed of off-site.

Survey-related sampling and analysis has been recommended to determine the potential for soil contamination and migration.

3.2.5.3.4 Category IV

None.

4.0 BIG HILL

The Big Hill site is located in Jefferson County, Texas, about 20 miles southwest of Beaumont, Texas, and about 70 miles east of Houston, Texas. The Big Hill site is situated on approximately 275 acres of land on the Big Hill salt dome with surface elevations of up to 37 feet above sea level (the highest elevations in the region). Less than a mile south of the dome is the northern boundary of fresh to intermediate marsh, which grades into brackish and saline marsh toward the Gulf of Mexico (Figure 4-1). Wetlands do not occur within the immediate vicinity of the site. The nearby waterways include Spindletop Ditch approximately 3 miles south of the site, which connects to the Intracoastal Waterway located 2 miles further south and oriented in a northeast to southwest direction. General freshwater impoundments are located south of the site. Numerous sloughs, bayous, and lakes, including Willie Slough Gully, Salt Bayou, Star Lake, and Clam Lake, connect with the Intracoastal Waterway. Natural ridges (cheniers) paralleling the coastline isolate the marsh from the Gulf of Mexico.

The Big Hill site is in an area used for grazing cattle and producing oil and natural gas. Land use patterns in this part of Jefferson County are not expected to change substantially in the future, due to limitations imposed by the marshy terrain and a lack of major roadways between Routes 73 and 87. There is sufficient land area available north of Route 73 to absorb urban expansion from the Beaumont-Port Arthur metropolitan centers.

In 1984, the population for the Beaumont-Port Arthur, Texas, MSA was 391,877. The 1984 estimated population of Jefferson County was 258,532 (USBC, 1986).

The undeveloped site was acquired in 1982. A new crude-oil storage facility has been under construction to provide a planned storage capacity of 140 million barrels. The original plans have been modified to increase the storage capacity to 160 million barrels to accommodate the future decommissioning of the Sulphur Mines site (DOE, 1987). Leaching of caverns was under way at the time of the on-site Survey.

4.1 Media-Specific Survey Findings

The discussions in this section pertain to existing or potential environmental problems in the air, surface water, and groundwater/soil media. The discussions include a summary of the available background environmental information related to each medium, a description of the sources of pollution and their control techniques, a review of the environmental monitoring program specific

FIGURE 4-1

BIG HILL, TEXAS, SITE LOCATION
STRATEGIC PETROLEUM RESERVE

to each medium, and a categorization and explanation of the environmental problems found by the Survey team related to each medium.

4.1.1 Air

4.1.1.1 Background Environmental Information

The air portion of the Environmental Survey of the Big Hill Site is designed to address existing and potential environmental impacts associated with releases of contaminants to the atmosphere, and includes a critical evaluation of air pollution sources and controls, and compliance with air pollution regulations. Adherence to established environmental procedures is evaluated from the standpoint of environmental problems or risks. Principal regulations relating to air emissions used as guidance during the Survey include

- The Clean Air Act (CAA) and Amendments
- Federal Regulations, including
 - National Ambient Air Quality Standards (NAAQS) (40 CFR 50)
 - Standards of Performance for New Stationary Sources (40 CFR 60)
 - National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61)
- Texas Air Control Board Rules and Regulations

The Big Hill salt dome is located in Jefferson County, Texas, which is included in the Southern Louisiana-Southeast Texas Interstate Air Quality Control Region (AQCR) No. 106 (40 CFR 81.53, July 1, 1987).

The national ambient air quality standards (see Table 3-1) have been incorporated into Texas air pollution control regulations and are enforced throughout the state. The attainment status of AQCR No. 106 is described (40 CFR 81.344, July 1, 1987) as follows:

Parameter	Status
Total Suspended Particulates	Better than National Standards
Sulfur Dioxide	Better than National Standards
Ozone	Does not meet Primary Standards
Carbon Monoxide	Cannot be Classified or Better than National Standards
Nitrogen Dioxide	Cannot be Classified or Better than National Standards

The status of other criteria pollutants, including PM-10 particulate matter and lead, has not been published.

Wind data recorded at Galveston, Texas, which is about 45 miles southwest of Big Hill, are representative of air-flow patterns along that section of the Gulf Coast. Characteristic wind patterns for stations near the SPR sites are discussed in Section 2.1.

4.1.1.2 General Description of Pollution Sources/Controls

Facilities at Big Hill that have potential for emissions to the atmosphere are covered by a Construction Permit (No. C-9256) issued by the Texas Air Control Board (TACB). The Permit addresses sources of volatile organic compound (VOC) emissions and establishes maximum allowable emission rates (TACB, 1983). The sources and allowable emission rates are as follows:

Source of VOC Emissions	Maximum Allowable Emission Rate	
	Pounds per Hour	Tons per Year
Blanket-Oil Tank	0.32	1.39
Oil Recovery Tank	0.18	0.81
Sump Tank	0.06	0.26
Fuel Tanks (3)	--	Nil
Valve Stems and Pump Seals	0.52	2.28

These sources are located at Big Hill, as shown in Figure 4-2. They handle either crude oil, gasoline, or diesel fuel. The pumps and some valves are located at the pump pad; other valves are at the cavern pads. The Permit allows the emission limitations shown above to be exceeded, provided the emissions result directly from the initial fill of the facility (TACB, 1983).

The Construction Permit also provides for three stationary diesel engines and establishes maximum allowable emission rates, which are shown in Table 4-1, for VOC, nitrogen oxides, sulfur dioxide, particulates, and carbon dioxide (TACB, 1983). No emission controls are required.

The Construction Permit will remain in effect as long as cavern leaching continues at Big Hill. Once the construction phase is concluded, the site will apply for an operating permit, which will provide essentially the same requirements as described in the Construction Permit.

FIGURE 4-2

LOCATION OF PERMITTED AIR-EMISSION SOURCES AT BIG HILL
STRATEGIC PETROLEUM RESERVE

TABLE 4-1

MAXIMUM ALLOWABLE EMISSION RATES FOR EMERGENCY DIESEL ENGINES⁽¹⁾
BIG HILL SITE
STRATEGIC PETROLEUM RESERVE

Source	Air Contaminant ⁽²⁾				
	VOC	NO _x	SO ₂	TSP	CO

EMERGENCY GENERATOR (16-83)

Emission Rate, lb/hr ⁽³⁾	1.48	18.50	1.23	1.32	4.00
Emission Rate, tpy ⁽⁴⁾	0.12	1.44	0.10	0.10	0.31

FIRE WATER PUMP (17-83)

Emission Rate, lb/hr	0.74	9.25	0.62	0.66	2.00
Emission Rate, tpy	0.06	0.72	0.05	0.05	0.16

EMERGENCY GENERATOR (18-83)

Emission Rate, lb/hr	0.04	0.50	0.03	0.04	0.11
Emission Rate, tpy	nil	0.04	nil	nil	nil

Source: TACB, 1983.

(1) Emission limitations based on an operating schedule of 156 hours per year.

(2) VOC = Volatile Organic Compounds

NO_x = Nitrogen OxidesSO₂ = Sulfur Dioxide

TSP = Total Suspended Particulates

CO = Carbon Monoxide

(3) lb/hr = Pound Per Hour

(4) tpy = Ton Per Year

4.1.1.2.1 Blanket-Oil Tank

A 20,000-barrel, above-ground tank, is included in the construction permit. The tank was originally intended to hold crude oil for use as blanket oil during cavern construction to protect the well casing seats in the cavern roof from unintentional leaching. However, cavern construction has proceeded much more rapidly than tank and pipeline construction, and blanket oil has been provided by truck. When completed, the tank will serve as a surge receptacle to contain crude oil released through pipes from high-pressure relief valves. The tank has an external floating roof with primary and secondary seals to minimize emissions of VOC. The tank is regulated by Standards of Performance for Storage Vessels for Petroleum Liquids Constructed After July 23, 1984 (40 CFR 60, Subpart Kb). The external floating roof with seals complies with Subpart Kb. Inspection of the seals is required within 60 days of initial fill, annually for secondary seals, and every 5 years for primary seals. The standards also require that records be maintained on quantity of petroleum liquid stored, period of storage, and maximum true vapor pressure.

4.1.1.2.2 Oil Recovery Tank

A fixed-roof, above-ground tank with a capacity of 10,000 gallons is located at the brine disposal pump pad to contain oil recovered from the brine solution as brine is displaced from a cavern during crude-oil injection. The tank is vented to the atmosphere.

4.1.1.2.3 Sump Tank

A 3,000-gallon oil-recovery sump tank (underground) is provided to collect oil drained from the crude-oil prover and metering skid and from the pig launcher/receiver. Collected oil is to be returned to the surge tank (blanket-oil tank) for injection into a storage cavern. The sump tank is vented to the atmosphere.

4.1.1.2.4 Fuel Tanks

Two 2,000-gallon underground storage tanks for fuels are located near the warehouse; one for gasoline and one for diesel. A third tank (500-gallon above-ground), located east of the raw-water intake structure, contains diesel fuel. All are vented to the atmosphere.

4.1.1.2.5 Valve Stems and Pump Seals

VOC emissions are possible if valve stems and pump seals leak. To minimize such emissions, the Construction Permit requires an inspection and maintenance program to detect and repair crude-oil leaks and consequent VOC releases. Because the site is in the construction phase, the inspection/maintenance program has not been fully developed. Thus, the number of valve stems and pump seals to be inspected had not been established at the time of the Environmental Survey.

4.1.1.2.6 Stationary Diesel Engines

Three stationary diesel engines are located at the Big Hill facility, two of which provide power to emergency electric generators. The third diesel engine provides power to a pump in firewater service. Each of these engines is intended only for emergency use during commercial power failure or when water is needed to fight a fire. The engines are run weekly for a 30-minute period to ensure operability. Emission limitations are stated in the Construction Permit (see Table 4-1).

4.1.1.2.7 Plant Road Dust

The Construction Permit requires that plant roads shall be sprinkled with water and/or chemicals as necessary to achieve maximum control of dust emissions. Watering practice at Wilber Road in the past has required one or two applications per day during dry periods. In September 1987, an application of sodium lignosulfonate solution proved far more effective and lasting than water alone. A follow-up application was scheduled for December 1987. During the construction phase at Big Hill, watering of in-plant roads is handled by the contractor (Homburg, 1987).

4.1.1.2.8 Space Heating

Space heating at Big Hill is provided by electricity.

4.1.1.3 Environmental Monitoring

4.1.1.3.1 Monitoring of Ambient Air Quality

Ambient air quality at Big Hill has not been monitored nor is any such monitoring planned. No requirements for ambient air quality monitoring are specified in the Construction Permit.

4.1.1.3.2 Calculation of Blanket-Oil Tank VOC Emissions

As part of the Construction Permit, Big Hill will be required to maintain a monthly record of calculated emissions of VOC from the blanket-oil tank once the tank is completed and in service (TACB, 1983). Emission calculations are to be made using the edition of AP-42, "Compilation of Air Pollutant Emission Factors," in effect on the date the Permit was issued (or amended). The major parameters considered in the calculation are crude-oil throughput and monthly average crude-oil temperature and vapor pressure. The record is to be made available to the TACB upon their request (TACB, 1983). These data are not required for the other tanks at Big Hill.

4.1.1.3.3 Monitoring of Fugitive VOC Emissions

The Construction Permit requires that routinely operated valves in VOC service shall be monitored for fugitive emissions at least quarterly, and that pump seals with potential to emit VOC shall be monitored at least quarterly. The results of the required fugitive monitoring and maintenance programs are to be made available to the TACB upon request.

4.1.1.4 Findings and Observations

4.1.1.4.1 Category I

None.

4.1.1.4.2 Category II

None.

4.1.1.4.3 Category III

None.

4.1.1.4.4 Category IV

None.

4.1.2 Surface Water

4.1.2.1 Background Environmental Information

4.1.2.1.1 Surface-Water Bodies in the Area

The major surface-water body near the site is the brackish Intracoastal Waterway (ICW), which runs southwest to northeast approximately 6 miles south of the site. The Gulf of Mexico lies another 4 miles further south. The man-made Spindletop Ditch, which drains Spindletop Bayou, flows west to east approximately 4 miles south of the site before turning south to join the ICW. The Spindletop Marsh lies between the site and Spindletop Ditch (Figure 4-1). The marsh is interspersed with small ponds and drainage canals and progresses from fresh to intermediate, to brackish as it gets closer to the ICW. A 10-acre freshwater pond is located on the northeast corner of the site (Figure 4-3).

4.1.2.1.2 Sources of Water Used at the Site

Pumps located at the intake structure on the ICW provide the raw water for cavern leaching, fire protection, brine line flushing, and brine pump seal flushing. Water for toilet flushing and hose connections at the main site operating area is supplied by a well. Water is trucked in to supply water for these uses at the two trailer office areas on the west and south sides of the site (Chatelain and Roberts, 1987). Commercial bottled water is used for drinking.

4.1.2.1.3 Flood Plain

The Big Hill site sits atop a salt dome and has an average elevation of 25 feet above mean sea level (MSL). It is the highest point in the surrounding area, and the operating area is not subject to flooding from surface runoff or from hurricane-induced tidal surges. The 100-year-flood elevation is estimated to be approximately 15 feet above MSL and 15.3 feet if the impact of a storm surge is added (Hart et al., 1981).

4.1.2.2 General Description of Pollution Sources/Controls

4.1.2.2.1 Water Uses at the Site

The major water uses at the site are supplied with raw water from the intake structure on the Intracoastal Waterway (ICW). This includes water for leaching (preparing the oil storage caverns as

Source: Adapted by DOE Environmental Survey Team from BPS, 1987h.

FIGURE 4-3

LOCATION OF 10-ACRE POND AT BIG HILL
STRATEGIC PETROLEUM RESERVE

described in Section 2.2.1), brine line flushing, brine pump seal flushing, and the fire protection system.

The bearing seals on the brine pumps must be continually flushed with raw water to prevent their being damaged (eroded) by insoluble materials in the brine. Because of the close tolerances involved in this application, the water used for seal flushing is flocculated and gravity settled to remove any particulate matter in the flush water. The particulates removed from the raw water are pumped to the anhydrite pond.

The fire protection system is also supplied with water from the ICW. Parts of the fire protection system at Big Hill, as is done at other SPR sites, will use Aqueous Film Forming Foam (AFFF) to improve the fire-extinguishing capabilities. This material is effective in covering and extinguishing hydrocarbon liquid-based fires. AFFF is obtained from a variety of suppliers through competitive bids. However, all the materials have similar characteristics of high biochemical and chemical oxygen demand (BOD and COD); are mostly biodegradable; contain 5 percent or less fluorocarbon surfactants, which are not biodegradable; and exhibit varying degrees of aquatic toxicity. These materials, however, are classified as practically nontoxic in the manufacturer's literature because the oral LD₅₀ for rats is greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered.) The oxygen depletion, due to the high BOD and COD, coupled with the aquatic toxicity could result in short-term environmental degradation if this material is released to adjacent surface water. The as-purchased concentrate is mixed with water to provide a 3 percent solution to be sprayed on the fire. The foam deluge system on the pump pads will have automatic foam proportioning systems to provide the required mixture. The fire monitors (water cannons) at the cavern pads use eductors to siphon the concentrate directly from drums placed adjacent to the monitor. The mobile fire-fighting equipment is also capable of using AFFF. SPR procedures call for annual testing of the fire protection systems and training of personnel. SPR has estimated that 19,663 gallons of 3 percent AFFF solution would be generated annually in training and testing exercises at Big Hill. Because the AFFF is biodegradable, the sewage treatment plant could treat the waste; however, the annual capacity of the existing systems for treating AFFF is only 1,520 gallons. The dikes at the cavern wellpads and oil surge tank will contain the foam used in fighting fire or training exercises at those locations, and catch basins are being installed in the initial construction to collect any AFFF that would be discharged in the main operating area. However, AFFF will not be brought on-site until an agreement is reached on proper disposal of this material. At the time of the on-site portion of the Survey, SPR was continuing dialogue with the state and investigating disposal options. Subsequent to the on-site portion of the Survey, the state ruled that fire-fighting fluids are oil-and-gas wastes and may be disposed of into Class II injection wells (Mullican, 1988). See Section 4.1.2.4.3 for a related finding.

Commercially supplied bottled water is used for drinking on the site. On-site well water is used for toilet flushing and for hose connections in the main operating area of the site. The site is preparing the paperwork to get this well registered with the state for potable water use. Water is trucked in from the City of Beaumont for use at the two trailer office areas on the west and south sides of the site. Three industrial wells that are registered with the state supplied water for the drilling operations on-site. At the time of the on-site portion of the Survey, water from these wells, instead of water from the ICW, was being put into the fire water storage tank. This was being done because of the site's concern that the brackish water (from the ICW) in the tank might have an adverse effect on the adjacent fresh water marshes, due to surface runoff when the water is used for fighting fires or for fire training exercises.

4.1.2.2.2 Brine Disposal

Brine from the caverns, during leaching and filling operations, is delivered to the anhydrite pond for insoluble material (anhydrite) to settle out. It then flows to the Brine Pond, which is divided, with one half being used for oil recovery and the other half for brine holding. The recovered oil is re-injected back into the system. The brine is then pumped to the Gulf of Mexico at a rate that allows the exit velocity through the individual diffusers to meet or exceed the NPDES permit limit of 20 feet/second. This rate has been established to permit adequate mixing with the sea water. If this was not done, a high salinity lens could develop on the floor of the Gulf in the diffuser area because the density of the brine discharge is greater than that of the sea water.

Oil/brine separators were not installed at Big Hill because of the difficulty experienced at other sites in trying to keep the anhydrite cleaned out of them. The anhydrite pond has been installed with a high-density polyethylene liner in place. When leaching operations are completed or the pond is filled with insolubles, the site intends to dewater the pond and put a cap on it for closure.

The NPDES permit for Big Hill requires hydrostatic testing of the brine line only prior to commencing operation. This was done prior to the October 1, 1987, start of leaching. It is expected that the permit will be modified by EPA upon its renewal to require semiannual integrity testing as is required at other sites discharging to the Gulf. As a possible alternative to hydrostatic testing, a method utilizing duplicate calibrated flow meters, installed in the brine line at the site and also in the first diffuser in the Gulf, is being evaluated at West Hackberry.

4.1.2.2.3 Sanitary Sewage

There are two packaged, extended aeration, activated sludge, sewage treatment plants adjacent to each other at Big Hill. Either one or both of them can receive the entire sanitary sewage flow from the Big Hill site. One has a rated capacity of 3,000 gpd and the other a capacity of 2,000 gpd. The total sewage flow at present is only between 500 and 1,500 gpd. The discharges from both units go to a sand filter for removal of any suspended material that does not settle out in the clarifier sections of the sewage treatment units. The sand filter effluent discharges to the 10-acre pond as Outfall 004.

To adequately clean the filter 1,200 gallons of filtered effluent water is pumped in the reverse direction (backwash) through the filter in a period of 15–20 minutes. This backwash water reenters the treatment system and upsets the operation because of the higher-than-normal flow rate. It is likely that even if the treatment plants were operating at their rated capacity, the introduction of this volume in the same time frame would cause operational upsets. The site has contacted the manufacturer and was making arrangements for a representative to visit the site to assist them in correcting the situation. In the meantime, raw sewage is being vacuumed out of the three lift stations on-site by a certified commercial sewage disposal contractor for proper treatment/disposal off-site.

4.1.2.2.4 Storm Water

Storm water from Big Hill runs off-site into the adjacent wetlands through the two ditches that drain the site at southeast and southwest corners. The 10-acre pond also receives storm-water runoff from the northeast area of the site. The overflow from this pond flows through the ditch at the southeast corner. Operational areas, such as cavern wellpads, pump pads, and the meter pad, that have the greatest potential for having oil or brine spills are diked (or will be diked when construction is complete). The storm water collected/contained in these areas is discharged through oil/water separators or, if uncontaminated, discharged directly to the drainage ditches on-site. The oil/water separators are operated in a batch mode, that is, storm water is not discharged from the pad through the oil/water separator until after the water has been analyzed and found to meet the NPDES discharge limits discussed later in Section 4.1.2.3.1. Furthermore, if any of the storm waters collected/contained in these areas are found to be saline, they are to be taken to the brine disposal system by vacuum truck.

The valves installed on the drain lines from the cavern pads to the oil/water separators and directly to the drainage ditches have been found to leak after storm events. The site has installed caps on the

end of the pipes as a temporary corrective action and is in the process of replacing or repairing the valves as needed.

4.1.2.3 Environmental Monitoring Program

4.1.2.3.1 NPDES Monitoring

The discharges from Big Hill are regulated by permits issued by the U.S. Environmental Protection Agency (EPA) and the Texas Water Commission (TWC). National Pollutant Discharge Elimination (NPDES) Permit TX0092827, issued by the EPA, has an effective date of January 18, 1984, and will expire on January 17, 1989. TWC Permit 02638 was issued on June 23, 1987 and will expire 5 years from that date.

The permitted discharge points and their designations are identical for Outfalls 001 and 002 in the two permits. The TWC permit designated Outfall 003 as a composite from each flowing CPI separator, while the NPDES permit does not have outfall numbers for these storm-water discharges but requires that the results of analyses from each discharging separator be attached to the discharge monitoring report. Outfall 004, the discharge from the sewage treatment plants, is only included in the TWC permit. These locations are listed in Table 4-2 and are shown in Figure 4-4. Outfall 001 is actually at the brine diffusers, 4 miles offshore in the Gulf of Mexico, but as required by the permit, the samples are taken downstream of the oxygen scavenger feed point, before the brine line leaves the pump pad.

The parameters to be measured, their limits, and the required sampling frequency for each outfall at Big Hill are listed in Table 4-3.

Because Big Hill is still under construction (in fact, leaching did not begin until October 1, 1987, only 2 months prior to the on-site Survey), monitoring results are limited. Only eight analyses were performed during 1986 on the discharges from the two oil/water separators in use then. All results were within the discharge limits in Table 4-3. As previously indicated, the samples for the storm-water discharges are actually taken from inside the containment dike on each wellpad prior to discharging the water through the oil/water separator.

TABLE 4-2
WATER SAMPLING LOCATIONS
BIG HILL SITE
STRATEGIC PETROLEUM RESERVE

Discharge Monitoring Stations	
001	Brine Disposal
002	Hydroclone and Blowdown at Raw-Water-Intake Structure
003	Storm-Water Discharges O/W1 Storm Water from Well Pads 101, 102, 106, 107 O/W2 Storm Water from Well Pads 103, 104, 105 O/W3 Storm Water from Well Pads 108, 109, 110 O/W4 Storm Water from Well Pads 113, 114 O/W5 Storm Water from Well Pads 111, 112 O/W6 Storm Water from Pump and Meter Pads O/W7 Storm Water from Crude Oil Surge Tank Dike O/W8 Storm Water from Transformer Sumps at Raw-Water-Intake Structure
004	Discharge from Sewage Treatment Plants

Water Quality Monitoring Stations	
A	Gulf Intracoastal Waterway
B	Ten-Acre Pond
C	Ten-Acre Pond
D	Ditch Southeast of Site
E	Ditch Southwest of Site

Source: Morris, 1988.

FIGURE 4-4

WATER SAMPLING LOCATIONS AT BIG HILL
STRATEGIC PETROLEUM RESERVE

TABLE 4-3
DISCHARGE MONITORING REQUIREMENTS AND EFFLUENT LIMITATIONS
BIG HILL SITE
STRATEGIC PETROLEUM RESERVE

Outfall	Parameter	Minimum	Daily Average	Daily Maximum	Measurement Frequency ⁽¹⁾	Sample Type
001 Bribe Diffuser to Gulf of Mexico	Flow	N/A	Report	71.4 mgd	Continuous	Record
	Oil & Grease	N/A	10 mg/L	15 mg/L	1/day	Grab
	Total Suspended Solids	N/A	Report	40 mg/l ⁽⁶⁾	1/week	Grab
	Total Dissolved Solids	N/A	Report	Report	1/week	Grab
	pH	6.0 S.U.	N/A	9.0 S.U.	1/month	Grab
	Dissolved Oxygen ⁽²⁾	Detectable	N/A	N/A	1/day ⁽²⁾	Grab
	Oxygen Scavenger ⁽²⁾	N/A	N/A	10 ppm NH ₄ HSO ₃ /ppm DO or 18 ppm K ₂ SO ₃ /ppm DO	1/day ⁽²⁾	Calculation
002 Hydroclone Blowdown to Intracoastal Waterway	Flow		Report	Report	1/week	Instantaneous
	Total Suspended Solids	6.0 S.U.	Report	Report	1/week	Grab
	pH	N/A	N/A	9.0 S.U.	1/month	Grab
003 ⁽⁴⁾ Storm-Water Runoff	Clarifying Agents ⁽³⁾	N/A	N/A	N/A	1/month	Inventory Calculation
	Oil & Grease	N/A	N/A	15 mg/L	1/day	
	Total Organic Carbon ⁽⁵⁾	N/A	N/A	75 mg/L	1/day	
004 ⁽⁶⁾ Sewage Treatment Plant Discharge	pH	6.0 S.U.	N/A	9.0 S.U.	1/day	
	Flow	N/A	0.005 mgd	0.0010 mgd	2/week	Instantaneous
	Biochemical Oxygen Demand	N/A	20 mg/L	45 mg/L	1/month	Composite
	Total Suspended Solids	N/A	20 mg/L	45 mg/L	1/month	Composite
	Chloride	1.0 mg/L	N/A	N/A	1/day	Grab
	pH	6.0 S.U.	N/A	9.0 S.U.	1/month	Grab

Source: NPDES Permit TX0092827 and Texas Water Commission Permit 02638.

(1) When discharge is occurring.

(2) Dissolved oxygen analysis is required only when an oxygen scavenger is being used. NH₄HSO₃ is used as the oxygen scavenger at Big Hill.

(3) Clarifying agents are not used at this location.

(4) TWC Permit 02638 designates Outfall 003 as a composite from each flowing CP1 separator. NPDES Permit TX0092827 does not have outfall numbers for these storm-water discharges but requires that the results of analyses from each discharging separator be attached to the discharge monitoring report.

(5) Federal requirements only.

(6) State Permit only; not listed in Federal Permit.

The sewage treatment plant was not operating properly at the time of the on-site Survey, and as discussed in Section 4.1.2.2.3, the raw sewage was being hauled off-site for treatment. Two noncompliances were reported in 1987. One was for low chlorine residual and another for not collecting a sample.

4.1.2.3.2 Surface-Water Monitoring

Big Hill plans to collect surface-water samples monthly at the locations designated by letters A through E in Figure 4-4. Point A is the ICW at the intake structure and will be representative of the water being provided to the site. Points B and C are in the 10-acre pond at the eastern edge of the site, which receives the discharge from Outfall 004, the sewage treatment plant. This pond overflows only infrequently, because rainfall and evaporation are approximately equal. Points D and E are to be in drainage ditches to the southeast and southwest of the site that receive the storm-water runoff from the site.

4.1.2.4 Findings and Observations

4.1.2.4.1 Category I

None.

4.1.2.4.2 Category II

None.

4.1.2.4.3 Category III

1. Potential Oxygen Depletion of Nearby Surface Water From the Discharge of Aqueous Film Forming Foam (AFFF). AFFF is used throughout the SPR because it is effective in covering and thus extinguishing hydrocarbon liquid-based fires. The release of untreated AFFF into surface waters can have an adverse impact on surrounding wetlands. Although the materials available at the SPR sites will vary slightly in composition, they are characteristically classified by the manufacturers as being biodegradable and practically nontoxic, having an LD₅₀ of greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered.) These materials also contain fluorocarbon surfactants (5 percent or less) that are not biodegradable. AFFF materials exhibit varying degrees of aquatic toxicity and have a high biochemical oxygen demand (BOD) and chemical

oxygen demand (COD). Therefore, AFFF, if discharged to adjacent surface water, could result in temporary oxygen depletion in those waters in addition to being toxic to some aquatic species. Although there is no restriction on its use in emergency situations, state regulatory agencies require that it be treated prior to discharge when used in training or performance tests. This creates a disposal problem. Under optimum conditions, sewage treatment plants of the types installed at the SPR sites can effectively treat waste AFFF material; however, 19,633 gallons of waste AFFF are expected to be generated annually during training exercises and performance tests at Big Hill. The treatment plant could handle only an estimated 1,520 gallons per year. Subsequent to the on-site portion of the Survey, permission was received from the state to dispose of AFFF as an oilfield waste into Class II injection wells (Mulligan, 1988). However, Big Hill does not yet have containment facilities in place to capture and retain the entire volume of material that would be discharged in training and testing exercises. The installation of adequate containment is included in the ongoing initial construction. The use of AFFF for training and performance testing purposes has been temporarily curtailed throughout SPR until the waste disposal issue is adequately addressed.

2. Potential Release of Contamination From Leaks in Cavern Pad Drain Valves. Leaks in wellpad drain valves could result in contamination of the soil, groundwater, and adjacent freshwater marshes in the event of a brine and/or oil spill on affected cavern pads. Valves on the drain lines from the containment dikes have been found to be leaking after storm events. These same valves would allow oil and/or brine to escape the containment dike in the event of a spill. The site has put caps on the ends of the discharge pipes as a temporary measure and is obtaining new valves.

4.1.2.4.4 Category IV

1. Potential Contamination From Brackish Waters Used in the Fire Protection System. Use of brackish water in the fire-water system could result in contamination of the soil, adjacent freshwater marshes, and possibly groundwater. Runoff of fire water used in drills, fire-fighting, and testing of the system could cause contamination of the soils and other waters (ground and/or surface) that it contacts. The fire-water system is supplied with raw water from the Intracoastal Waterway intake, which has a salinity of 5 to 20 ppt. The site is aware of this potential problem and, at the time of the on-site Survey, was planning to fill the system with fresh groundwater from the industrial wells on-site.

4.1.3 Groundwater/Soil

4.1.3.1 Background Environmental Information

The Big Hill salt dome is located 9 miles (14.4 km) northwest of the Gulf of Mexico, 5.3 miles (8.5 km) north of the Intracoastal Waterway (ICW), 3.2 miles (5.1 km) north of the Spindletop Ditch (a barge canal connecting to the ICW), and immediately north of an extensive marsh area stretching to the coast. This marsh is fresh to intermediate near the site and north of the ICW, grading into brackish and saline near the Gulf. These extensive wetlands are part of the Sabine Basin (SPRO, 1978b; Johnson, 1981).

The salt dome is a conspicuous topographic feature of the local area. It rises more than 25 feet (7.5 meters) above the surrounding plain to a maximum elevation of 37 feet (11 meters) above mean sea level. Depth to salt is approximately 1,600 feet (490 meters) below sea level.

The sediments overlying the salt dome are sands and clays deposited unevenly by meandering rivers in flood plains and deltas. Lenses and layers of variable thickness occur as a result of this stream deposition. Borehole logs from well drilling in the southeast part of the site indicate that brown clay is present at the surface to a depth of 7 to 35 feet (2 to 11 meters). The clay is underlain by variable thicknesses of interbedded fine white sand and stiff blue clay. In other parts of the site the surface layer may be sand and fine silt, underlain by clay. Low, sandy, circular mounds known as pimple mounds are found in the area; these give the land surface a mottled appearance. They are about 1 to 5 feet (up to 1.5 meters) in height and 20 to 50 feet (6 to 15 meters) in diameter. The area around the site has been used primarily for pasture land and oil development, although rice is cultivated away from the dome on the poorly drained clay soils.

Caprock is found over the dome at a depth of 195 feet (60 meters) below the surface. Extensive sulfur exploration at Big Hill has shown that no economic deposits of sulfur exist in this caprock, unlike Bryan Mound and Sulphur Mines.

The important hydrogeological units in the Big Hill area are the Upper Chicot and Lower Chicot units of the Chicot aquifer system. The Upper Chicot in eastern Texas includes sediments of Pleistocene and Holocene age. The town of Winnie, Texas, 8 miles (13 kilometers) northwest of Big Hill, withdraws groundwater from this unit for industrial, municipal, and irrigation supplies. In 1966, measured water levels were at sea level at Big Hill and 30 feet below sea level at Winnie due to pumping (SPRO, 1978b). Thus, it is assumed that groundwater in the upper part of the Chicot

aquifer tends to move northwest under the influence of pumping rather than following the natural pathway southward to the Gulf of Mexico.

Fresh water (defined as 0–1,000 mg/L total dissolved solids) is present over the dome only to a depth of approximately 135 feet. To the northwest, the fresh-water/salt-water interface is at a depth of about 200 feet, and slightly saline water (1,000–3,000 mg/L total dissolved solids) is present at Winnie to a depth of approximately 500 feet. The presence of salt water at relatively shallow depths near the dome may be due to vertical movement of deeper salt water around the flanks of the dome or to dissolution of salt from the dome (SPRO, 1978b). A major northwesterly trending fault is known to be present through the Big Hill area. It may have influenced the emplacement of the dome itself and may still be affecting the position of the fresh-water/salt-water interface.

Farther away from the dome, fresh water is found in the Lower Chicot unit (which in eastern Texas is equivalent to the Louisiana units described in Section 2.1.7 as the Shallow Chicot plus the "200-foot," "500-foot," and "700-foot" sand units of Pleistocene age). The Lower Chicot is used for water supplies in the Beaumont-Port Arthur area in easternmost Jefferson County. Due to the influence of this Beaumont-Port Arthur pumping center, 20 miles (32 kilometers) to the northeast of Big Hill, groundwater in the Lower Chicot moves southeast to eastward rather than south-southeast toward the Gulf of Mexico.

An additional center of groundwater withdrawal is at Baytown, Texas, 40 miles (64 kilometers) west of Big Hill. At this location the Lower Chicot is tapped for agricultural, municipal, and industrial uses. No current information on groundwater pumpage is available.

Domestic use in the immediately vicinity of the site is not recorded. However, the Pipkin's home, due north of the northeast corner of Big Hill, has a drinking water well about 1 mile from the site's boundary (BPS, 1987i). It is likely that this shallow well taps the Upper Chicot.

Three water supply wells are located in the southeast part of the site. These were used during drilling operations. No completion diagrams were available for these wells. They are intended to be used for fire water as a temporary fresh water source to replace the brackish water previously used in the fire system (see Section 4.1.2.2.1).

A potable water well 40 feet (12 meters) deep was drilled in 1985 north of the control building. The borehole log indicates clay to 30 feet and sand from 30 to 40 feet. The static water level was 15 feet below the surface, and the well produced 25 gallons per minute (gpm). Initial sampling indicated

good quality water with total dissolved solids 93 mg/L, manganese 0.03 mg/L, iron 0.03 mg/L, nitrate 0.11 mg/L, and pH 7.2.

4.1.3.2 General Description of Pollution Sources/Controls

4.1.3.2.1 Brine Ponds

The brine ponds at the Big Hill SPR facility are lined earthen impoundments used for storage of brine produced in the solution mining and oil storage process. The ponds include the anhydrite pond (Pond No. 9), the oil recovery pond (Pond No. 37), and the brine pond (Pond No. 7) (Figure 4-5).

The design of the ponds includes several features to prevent migration of salt water into area groundwater. These features include synthetic liners, underdrain systems, a natural clay bottom barrier, and surrounding bentonite-clay slurry walls interfaced to the natural clay bottom (SPR, undated).

The anhydrite pond, the oil recovery pond, and the brine pond share the same slurry wall and perimeter dike. The oil recovery pond and the brine pond are divided by a center dike and underflow weir; they share a common internal slurry wall with the anhydrite pond.

The anhydrite pond is a low velocity basin that allows anhydrite particles to settle from the brine. From the anhydrite pond, the brine overflows two weirs into the oil recovery pond. The oil recovery pond is equipped with skimming equipment to recover any floating oil. From the oil recovery pond, the brine flows under a weir to the brine pond.

The interior of the ponds is lined with oil-resistant, reinforced high-density polyethylene (HDPE) sheeting. The 40-mil HDPE synthetic liner is designed to provide the primary barrier to migration of the brine. The synthetic liner covers the entire wetted surface of the ponds and is anchored into the crown of the dike. The liner is vented along the top of the dike. The oil recovery and brine pond liners are covered with a protective coat of concrete.

The synthetic liners are underlain by subdrain (underdrain) systems designed to collect any liquid passing through the synthetic liner. The subdrain system consists of geotextile fabric, filter media, and piping that transports the leachate water to a collection sump. The anhydrite pond has its own underdrain system, whereas ponds 7 and 37 share a common underdrain system.

FIGURE 4-5

BRINE PONDS AND ASSOCIATED MONITORING WELLS AT BIG HILL STRATEGIC PETROLEUM RESERVE

The purpose of the underdrain system is two-fold. It provides both a mechanism to detect leaks in the synthetic liner and a pathway for collection of liquids for removal. Accumulated liquid in the collection sump is tested for elevated conductivity (a measure of salt content), which would indicate that the liquid originates from pond leakage rather than from possible infiltration of uncontaminated groundwater into the system.

An additional barrier to vertical migration of brine, beyond the barriers provided by the synthetic liners and underdrain collection systems, is the presence of at least 10 feet of relatively impermeable, stiff, blue clay beneath the ponds. This natural clay layer is just below the underdrain system at the anhydrite pond, and is found at a depth of approximately 17 feet below the ground surface east and southeast of the ponds. North of the anhydrite pond and north, west, and south of the oil recovery and brine ponds, the clay layer is found at a greater depth of approximately 41 feet.

Subsurface layers of greater permeability are present above the blue clay. Horizontal migration of any contaminants that pass beyond the liners and leachate collection systems could occur through these more permeable layers.

However, such horizontal migration is blocked by the presence of a bentonite-clay slurry wall. This 30-inch-wide slurry cutoff wall is a stable colloidal suspension of bentonite in water. The slurry wall is located within the dikes around the perimeter of the ponds and along the levee dividing Pond 9 (anhydrite pond) from ponds 7 and 37. At the anhydrite pond this cutoff wall extends from 1 foot above ground level (within the dike) to a depth of 24 feet, where it is keyed into the stiff blue clay layer (the clay layer extends from approximately 17 to 30 feet at the anhydrite pond). At ponds 7 and 37, where the clay layer is found at greater depth, the slurry wall extends from the surface to a depth of 55 feet.

Four piezometers are located on the dike surrounding ponds 7 and 37, inside the slurry wall. Locations are shown on Figure 4-5 as A, B, C, and D. These are 2-inch wells extending to a depth of 27 feet, 10 inches. They were not gravel packed and do not produce significant amounts of water. Accordingly, they are not functional as a monitoring system, although occasional samples have been taken (see Section 4.1.3.3).

These control systems - synthetic liner, underdrain, natural clay bottom, and slurry walls - were all part of the original construction of the brine disposal ponds at Big Hill. This construction was completed during 1986. Unfortunately, the HDPE synthetic liner developed leaks. Multiple leaks were identified and repaired between June 1987 and September 1987 in the 250,000 barrel anhydrite pond. Dye tracers were used to identify leaks. Fluorescein dye was added to the pond

contents, and the collection sump liquid was visually and spectrophotometrically checked for the presence of dye. Both the brine pond and the anhydrite pond were investigated by this method; the brine pond liner was found to be intact. Leaks in the anhydrite pond liner have been found and repaired three times, and any liquids accumulating in the collection sumps are analyzed to detect the presence of new leaks that may develop.

The presence of salt contamination in the underdrain system indicates a failure in the synthetic liner. However, it does not indicate that the contaminant has penetrated the slurry wall and the bottom clay barrier. A secondary leak detection system was installed in September 1987. This system consists of six groundwater monitoring wells located outside the slurry wall. The well locations are shown on Figure 4-5. The purpose of the monitoring well program is to verify that penetration of the slurry wall has not occurred. If significantly elevated conductivity is found in the groundwater, pond shutdown procedures will be implemented (SPR, undated).

This monitoring well program is discussed further in Section 4.1.3.3.

4.1.3.2.2 Contamination of Leaching Wells

As discussed in greater detail in Section 4.2.5.2.2, many of the wells drilled into the Big Hill salt dome for leaching of storage caverns were found to be contaminated with organic and inorganic priority pollutants. Since the interior of the salt dome is isolated from the aquifers surrounding the dome, this contamination has little potential to affect groundwater. However, it does constitute subsurface contamination. This contamination is being removed from the cavern wells within the salt dome in two ways. The first method will be applied to 23 wells with low levels of contaminants (those below EP toxicity or EPA reportable quantity limits). Removal of fluids from these 23 wells will be done by dilution during leaching and disposal through the brine line to the Gulf of Mexico. The second method will be used for the remaining five wells that have higher levels of contamination. For these five wells with levels of contaminants exceeding the EP toxicity or EPA-reportable-quantity limits (see Section 4.2.5.2.2), removal will be accomplished by flushing the contaminated brine into frac tanks and disposing in off-site injection wells. Analysis of the flushed material will determine whether disposal as hazardous waste or as nonhazardous oilfield waste is required. For two of the five more contaminated wells, 108B and 103A, flushed brine has been found to be nonhazardous. Fluids from Well 108B have been disposed of in the Trinity Products oilfield waste injection well (see Section 4.1.3.2.3), and the same disposal method will be used for the fluids from Well 103A. The remaining three wells have not yet been flushed. The brine that remained in Wells 108B and 103A after flushing was clean enough to require no further special treatment. It was calculated that this brine would meet chronic marine water quality criteria after dilution at the brine diffusers in the

Gulf (Gray, 1987a; 1987b; 1987c; 1987d), and leaching therefore proceeded as scheduled under the terms of agreements with both the EPA and the Texas Water Commission.

4.1.3.2.3 Oilfield Waste Injection Wells

Although no brine disposal injection wells are operated by the SPR at Big Hill (unlike Sulphur Mines, Bayou Choctaw, or West Hackberry), industrial disposal wells are or have been in use near the site. Such wells can become sources of environmental contamination if leaks develop in the tubing, casing, or packer. Injected fluids or formation fluids can also migrate if channels develop in the cement between the casing and the formation. For these reasons, periodic testing is required. Spillage of fluids at the surface facilities associated with such wells can cause soil or shallow groundwater contamination. The Trinity Products, Inc., disposal well is located adjacent to the southwest corner of the site. (This well is also known as Stubblefield's.) It is an approved Railroad Commission of Texas Salt Water Disposal (SWD) well; the permit was granted July 23, 1965, to a previous operator and transferred to Trinity Products on September 1, 1976.

This commercial facility is used by the SPR for any brine which is chemically unsuitable for disposal through the Big Hill brine pipeline to the Gulf of Mexico. It is used in preference to other facilities because of a general SPR policy to limit the use of disposal well facilities to those already in use by the SPR. The intent of this policy is to avoid additional liability if wells require future environmental cleanup and the SPR is held partially responsible for materials disposed of at these facilities (Bozzo, 1987).

The Trinity Products well is just off the flank of the salt dome. The permitted depth interval for brine injection is 1,070 to 1,475 feet. This interval is well below the depths at which fresh (less than 200 feet) and slightly saline (less than 500 feet) groundwater is found in the vicinity of the dome. Well integrity testing is required by the Railroad Commission of Texas to avoid contamination of underground sources of drinking water. Verification of such testing for an off-site, non-DOE, commercial well, and consideration of potential effects of surface operations at the disposal well storage tank area on shallow groundwater were beyond the scope of the Survey. However, it is likely that shallow groundwater at the tank location would move northwest and south, away from the dome and the Big Hill SPR site.

The storage tanks for the Trinity Products well were formerly located on the Big Hill site but were moved off-site after DOE acquisition. The former tank location was covered over by topsoil from site wellpad construction.

As discussed in Section 4.2.5.2.4, Amoco also operated a brine disposal well on-site prior to DOE acquisition. This well has been plugged and abandoned. It was located on the east flank of the dome, near the site entrance.

4.1.3.2.4 Drilling Mud Ponds

As discussed in Section 4.2.5.2.3, one freshwater mud and cuttings disposal area and three saltwater mud and salt cuttings ponds are present at Big Hill. These ponds (reserve pits) have been closed in accordance with Railroad Commission of Texas Rule 8. The freshwater mud area was unlined; closure consisted of backfilling and seeding. Prior to closure of the saltwater cuttings ponds all four areas were tested for EP toxicity and found to be nonhazardous. This testing was done as part of the SPR CERCLA Phase II investigation.

The saltwater cuttings ponds were lined with polyethylene and equipped with an underdrain system during their active life. Surface water accumulation and water from the underdrain was sent to the Stubblefield well, possibly through a direct pipeline. The primary purpose of the underdrain was to keep the liner from floating. However, liner damage and leaks occurred occasionally, according to site personnel. The ponds were cement stabilized and closed in 1986. The surface is now grassy.

Surface water in the vicinity, and possibly near-surface groundwater both discharge into drainage ditches leading from these closed ponds. Some rust was observed in the ditches; metal undertiles were said to be used in construction of the pond underdrain system and this could account for the rust.

Valves from the underdrain system are kept closed. The underdrain is checked visually for salt buildup on valves, and there is visual inspection for salt at outfalls. Salt buildup in the ditches did occur when upset conditions, such as leaky valves or leaky liners, were present. Shallow groundwater contamination from salt leakage may have occurred. However, there should be little current potential for any salt migration from these closed ponds due to cement stabilization.

4.1.3.3 Environmental Monitoring Program

The six monitoring wells at the brine disposal ponds are constructed of 4-inch PVC. Borehole logs and well construction data were available, and all features, including concrete slabs and well caps, appeared to be in conformity with accepted practice.

The wells were installed in September 1987 and are to be sampled monthly from the start of leaching. The written sampling procedure states that the wells are sampled by a submersible pump and PVC pipe. This pipe is attached to a flow meter to measure the amount evacuated before sampling. One-hundred gallons are purged from Wells 2 and 3 before a sample is taken; 40 gallons are purged from Wells 1, 4, 5, and 6. Analyses include salinity, conductivity, and pH. The use of a pump rather than a bailer should be adequate for these parameters, since loss of volatiles is not a consideration.

The piezometers on the dike around the brine pond proved inadequate to provide meaningful data and are no longer used.

Available monitoring data are shown in Table 4-4. There is no indication of contamination originating from the brine ponds. Well 1 appears to be contaminated by comparison to other wells, but a source external to the slurry wall is indicated. Construction activities have been occurring near this well. Such activities probably account for the high initial values for chloride, sodium, total dissolved solids, salinity, and specific conductivity. Salinity and conductivity measurements have been lower in subsequent sampling rounds for Well 1.

4.1.3.4 Findings and Observations

4.1.3.4.1 Category I

None.

4.1.3.4.2 Category II

None.

TABLE 4-4

**MONITORING WELL DATA
BIG HILL SITE
STRATEGIC PETROLEUM RESERVE**

INITIAL SAMPLING 9/28/87

Well Number Well Depth Screened Interval	1 43' 33'-43'	2 42' 8" 12' 5" - 42' 5"	3 42' 5" 7' 5" - 42' 5"	4 17' 4" 7' 4" - 17' 4"	5 15' 6-1/2" 5' 6-1/2" - 15' 6-1/2"	6 37' 10-3/4" 27' 10-1/4" - 37' 10-3/4"
Bicarbonate (mg/L) ⁽¹⁾	130	42	38	90	175	145
Carbonate (mg/L) ⁽¹⁾	<10	<10	<10	<10	<10	<10
Sulfate (mg/L)	825	12	8	41	25	37
Chloride (mg/L)	8,500	28	30	45	40	350
Calcium (mg/L)	231	4.8	4.1	6.2	16.6	91
Magnesium (mg/L)	450	2.9	1.8	3.2	5.0	20.4
Sodium (mg/L)	3,460	15.5	14.8	49.6	27.2	149
Iron (mg/L)	0.18	0.98	0.81	36	62	2.6
Total Dissolved Solids (mg/L)	14,300	148	122	692	1,152	1,030

TABLE 4-4
MONITORING WELL DATA
BIG HILL SITE
STRATEGIC PETROLEUM RESERVE
PAGE TWO

ROUTINE SAMPLING

Well Number Well Depth Screened Interval	1 43' 33'-43'	2 42' 8" 12' 5"-42' 5"	3 42' 5" 7' 5"-42' 5"	4 17' 4" 7' 4"-17' 4"	5 15' 6-1/2" 5' 6-1/2"-15' 6-1/2"	6 37' 10-3/4" 27' 10-1/4"-37' 10-3/4"
pH (units)	7.3 6.9 7.2	6.3 6.1 6.1	7.1 5.9 5.9	6.8 6.8 6.9	7.3 7.0 7.1	7.5 7.5 7.4
Salinity (ppt)	13.3 5 2	0.2 0 0	0.1 0 0	0.2 0 0	0.3 0.5 0	1.0 0.2 0
Spec. conductivity (µmhos/cm)	23,800 8,800 3,300	140 136 130	129 127 115	305 270 270	580 700 700	1,500 610 550
Total Organic Carbon (TOC) (mg/L)	NA 12 6	NA 5.8 3	NA 4.4 8	NA 5.3 5	NA 13.2 10	NA 67 5

TABLE 4-4
MONITORING WELL DATA
BIG HILL SITE
STRATEGIC PETROLEUM RESERVE
PAGE THREE

SINGLE SAMPLING ROUND

Piezometer	A	B	C	D
pH (units)	6.3	6.1	6.1	6.5
Salinity (ppt)	0.5	0	0	1
Spec conductivity ($\mu\text{mhos/cm}$)	1,000	138	122	1,720
TOC (mg/L)	5.6	13.2	8.3	56

Source: Holliday, 1987.

NA = not analyzed

(1) Reported as calcium carbonate.

4.1.3.4.3 Category III

None.

4.1.3.4.4 Category IV

None.

PRELIMINARY

4.2 Non-Media-Specific Survey Findings

This section discusses findings and observations pertaining to waste management, toxic and chemical materials, radiation, quality assurance, and inactive waste sites and releases. These discussions do not include a background environmental information section, because the areas addressed are not necessarily tied to one medium, as was the case with the discussions in Section 4.1. These discussions include an environmental monitoring program section, where appropriate and where information was available.

4.2.1 Waste Management

4.2.1.1 Background Information

The Big Hill site generates various oil-and-gas wastes and municipal solid wastes, as well as small quantities of hazardous wastes. The site does not generate any industrial solid wastes, radioactive wastes, or radioactive/hazardous mixed wastes. Brief descriptions of these wastes are as follows:

- Oil-and-gas wastes are wastes arising out of or incidental to drilling for or producing of oil, gas, or geothermal resources; wastes arising out of or incidental to the underground storage of hydrocarbons other than storage in artificial tanks or containers; or wastes arising out of or incidental to the operation of gasoline plants, natural gas processing plants, or pressure maintenance or repressurizing plants (MOU, 1987).
- Industrial solid wastes are wastes resulting from or incidental to any process of industry or manufacturing, or mining or agricultural operations [Texas Solid Waste Act, Section 2(14)].
- Municipal solid wastes are wastes resulting from or incidental to municipal, community, commercial, institutional, and recreational activities including garbage, rubbish, ashes, street cleanings, dead animals, abandoned automobiles, and all other solid waste other than industrial solid waste [Texas Solid Waste Act, Section 2(17)].
- Hazardous wastes are those wastes identified as such in 40 CFR 261 [i.e., regulated under the Resource Conservation and Recovery Act (RCRA)] [Texas Solid Waste Act, Section 2(13)]. Such wastes are either ignitable, reactive, corrosive or toxic, or contain materials listed in 40 CFR 261.

- Radioactive wastes are wastes containing radioactivity (i.e., materials that emit radiation, such as alpha and beta particles, neutrons, electrons and gamma rays).
- Mixed (radioactive and hazardous) wastes are co-contaminated with radioactive and hazardous waste materials.

Most of the wastes generated at Big Hill are oil-and-gas wastes. Activities that generate these wastes are listed below (MOU, 1987). Oil and gas wastes are regulated by the Railroad Commission of Texas (RCT). Specifically, ponds and pits used to hold or dispose of oil and gas wastes, such as the Big Hill anhydrite settling pond, the oil recovery pond, and the brine pump pond, must be permitted (Rule 8; RCT, undated). The site must also use carriers to transport such wastes off-site who are permitted by the state.

Activity	Waste
Drilling, operation, and plugging of wells	Drilling fluids (including water-based and oil-based fluids), cuttings, produced water (brine), produced sand (anhydrite), waste hydrocarbons (including used oil), fracturing fluids, spent acid, workover fluids, treating chemicals (including scale inhibitors, emulsion breakers, paraffin inhibitors, and surfactants), waste cement, filters, and trash (including barrels, dope cans, oily rags, mud sacks, and garbage).
Storage of Oil	Tank bottoms, storm-water runoff.
Underground hydrocarbon storage	Saltwater (brine).

Oil-and-gas wastes are temporarily exempted from regulation as hazardous wastes under Section 3001(b)(2)(A) of the 1980 amendments to RCRA pending further study by EPA. After submission of study results to Congress, and public hearings and opportunity to comment, the Administrator of EPA must determine either to promulgate regulations under the hazardous waste management provisions of RCRA (Subtitle C) or to declare that such regulations are unwarranted. Because wastes arising out of or incidental to the underground storage of hydrocarbons are considered oil-and-gas wastes in Texas (see oil-and-gas waste definition above), the temporary exemption applies to the Big Hill oil-and-gas wastes. Exempted wastes are defined in detail in the Report to Congress, Management of Wastes from the Exploration, Development, and Production of Crude Oil, Natural Gas, and Geothermal Energy (EPA, 1987a).

Municipal solid wastes are regulated by the Texas Department of Health (TDH). Because all of these wastes generated at Big Hill are either disposed of or reclaimed off-site, no TDH permit is required.

Hazardous wastes are regulated by the Texas Water Commission (TWC). TWC was granted authorization from EPA in December 1984 to manage the RCRA hazardous waste program in Texas. Regulations that apply to Big Hill as a hazardous waste generator are contained in the Texas Industrial Waste Management Regulations (Texas Administrative Code, Title 31, February 1988). Because Big Hill is a small quantity generator, it is subject to Section 335.78 of these regulations.

4.2.1.2 General Description of Pollution Sources/Controls

4.2.1.2.1 Oil-and-Gas Wastes

Oil-and-gas wastes managed at the Big Hill SPR consist of wastes generated from cavern development and oil storage activities, such as brine, anhydrite, and slop oil (i.e., small quantities of crude oil spilled or leaked during routine operations). Drilling muds and salt cuttings from cavern well installation are no longer being generated (past disposal of drilling muds and salt cuttings is discussed in Section 4.2.5.2). In addition, tank bottoms (e.g., oily sediments from cavern pad sumps and oil/water separators) and oil-contaminated soils from spills were not being generated; at the time of the Survey, the site was still under construction and had not received any significant quantities of crude oil for storage. Brine is piped to the Gulf of Mexico for disposal (refer to Section 4.1.2.2.2). Anhydrite is collected in the anhydrite settling pond, which will be closed and covered when full or upon completion of cavern leaching operations. SPR has indicated that if the quantity of anhydrite to be handled during cavern leaching operations is larger than the pond capacity, another pond will be constructed for anhydrite disposal. All other wastes are shipped off-site for disposal or reclamation. Some brine, oily liquid wastes, and flushings from contaminated leaching wells (refer to Section 4.2.5.2.2) are sent via vacuum truck to the Trinity Products, Inc. site, located adjacent to the Big Hill site, for underground injection. Slop oil is sent to Phoenix Oil, Inc., in Humble, Texas, to be reclaimed. According to site personnel, oily sorbent pads and rags are supposed to be put into plastic bags, stored in designated dumpsters, and sent to the Waste Management Golden Triangle landfill in Nederland, Texas.

Brine and anhydrite are handled by a three-pond system (see Figure 4-5). Brine is pumped from the caverns to the anhydrite settling pond, where anhydrite accumulates. The brine then flows into the oil recovery pond, through two weirs, where oil is skimmed off. Brine leaves this pond and enters the brine pond through a barrier wall dividing the two ponds. The weir in the barrier wall has nine square orifices, 2 feet by 2 feet, located at the bottom of the wall to allow brine passage from the oil recovery pond to the brine pond while restricting oil passage. The brine is pumped into the brine disposal pipeline from the pump platform and sump located in the northeast corner of the brine

pond. The anhydrite settling pond measures 333 feet by 333 feet and has a volume capacity of 250,000 barrels (10.5 million gallons). The oil recovery pond and the brine pump pond together measure 314 feet by 303 feet, and each has a volume capacity of 100,000 barrels (4.2 million gallons). All three ponds have a synthetic liner and an underdrain system to collect any leakage through the liner. The oil recovery pond and the brine pump pond also are lined with 3 inches of concrete. In addition, there is a bentonite-clay slurry wall that surrounds the ponds beneath their dikes and at least 10 feet of relatively impermeable clay beneath the ponds to confine any leakage not collected by the underdrain system sump. The anhydrite settling pond and the oil recovery and brine ponds received RCT permits in 1987 (Pit Permit No. P000226A, Amended, and No. P000226B, respectively).

At the time of the Survey, the liner in the anhydrite settling pond continued to leak after having been repaired three times. Leak testing conducted at the oil recovery pond and the brine pump pond indicated that the liners were not leaking (Morgan, 1987). A groundwater monitoring program was established to determine if brine leaking from the anhydrite settling pond was escaping the underdrain system and possibly penetrating the slurry wall and the bottom of the clay barrier (refer to Sections 4.1.3.2.1 and 4.1.3.3).

4.2.1.2.2 Municipal Solid Wastes

Nonhazardous municipal wastes generated at Big Hill include trash, construction debris, and used hydraulic and lubricating oil. Trash and debris are sent to the Waste Management landfill. Used oil is sent along with slop oil to the Phoenix Oil facility to be reclaimed. Solids from the sewage treatment plant had not yet been generated; at the time of the Survey, the plant was not on-line.

4.2.1.2.3 Hazardous Wastes

Big Hill generates small quantities of hazardous wastes, including paint wastes and solvents. Most of the hazardous substances used on-site, including the majority of solvents, are consumed, and thus to the Survey team, less than 100 kilograms per month of hazardous wastes appeared to be generated. At the time of the Survey, this waste was being stored at the west end of the BPS Laydown Yard awaiting removal for off-site disposal or reclamation at an approved facility. Less than 100 kilograms of hazardous wastes were accumulated, and none had yet been sent off-site. Based on the amounts of hazardous waste generated and accumulated, Big Hill is a conditionally exempt, small-quantity generator according to Texas Industrial Waste Rules, Section 335.78.

At the time of the Survey, the means of waste storage at the BPS Laydown Yard were insufficient to protect the drums from the natural elements and to contain any material released in the event of a

spill (refer to Section 4.2.2.2.3). A temporary, construction-related, diked area, about 100 feet by 50 feet and lined with polyethylene, contained a "frac-tank," which held the potentially contaminated fluids from leaching wells (refer to Section 4.2.5.2.2), and 10 drums (about 550 gallons) of nonhazardous paint wastes, spent solvents, and slop oil. Some of the drums had open bungs, permitting the release of volatile organic compounds, and others had rainwater accumulated on their tops. The overall condition of several of these drums appeared to be deteriorated. There was also standing water in the diked area, a situation which would promote drum deterioration if more water were to accumulate and come in contact with the stored drums. Furthermore, the storm-water discharge valve had been left in the open position unattended. If there had been a leak or spill, hazardous wastes could have been released from the pad into the adjacent storm-water drainage ditch. In addition, five drums of slop oil were being stored in an open area adjacent to the diked area. These drums were on gravel in an uncontained area, and one did not have a cover, a factor which would allow rainwater to accumulate and wastes to overflow. This waste storage area at the west end of the BPS laydown yard (Figure 4-6) was inspected by the BPS site environmentalist in November 1987, and the following waste storage deficiencies were noted (Morris, 1987a):

- Open drums.
- Stacked drums, making inspection impossible.
- Drums stored on the ground, rather than on pallets.
- Lack of impervious base under some drums.
- Lack of waste drum inspection program.
- Lack of records of drum contents.
- Inadequate drum labeling.
- Evidence of leaks and spills.

4.2.1.2.4 Underground Storage Tanks

At the time of the on-site Survey, there were three underground storage tanks (USTs) in place at the Big Hill site. One of the USTs is for gasoline, another is for diesel, and the third is for collecting oil in the event there is a leak or spill on the raw-water-intake structure. The fuel tanks are located near the warehouse at the main site, are made of fiberglass-reinforced plastic, and have a 2,000-gallon capacity. The tank at the raw-water-intake structure was installed to receive oil from an oil/water separator put in place as a spill control measure. This tank is made of steel and has a 3,000-gallon capacity. Although SPR did not have a leak detection program for USTs at the time of the Survey, the

FIGURE 4-6

TOXIC AND CHEMICAL MATERIALS STORAGE AREAS AT BIG HILL
STRATEGIC PETROLEUM RESERVE

Source: BPS, 1997

potential for UST leakage appeared to be low and does not present, at this time, a significant environmental risk. The tanks were installed in 1985 and were thought to be in relatively good condition. The two fuel tanks and a fourth tank, which is intended for recovered oil and had not yet been installed at the time of the Survey, were reported to the TWC pursuant to RCRA Subtitle I (Gray, 1986a). The tank at the raw-water-intake structure was not reported (refer to Section 4.2.1.3.4).

4.2.1.3 Findings and Observations

4.2.1.3.1 Category I

None.

4.2.1.3.2 Category II

None.

4.2.1.3.3 Category III

None.

4.2.1.3.4 Category IV

1. Inaccurate Underground Storage Tank Report. The listing of underground storage tanks at Big Hill that was submitted to the State of Texas by SPR is incomplete.

Section 9002 of the Resource Conservation and Recovery Act (RCRA) requires owners of underground storage tanks (USTs) that were used to store waste and non-waste toxic and chemical materials after January 1, 1974, to submit a listing of such tanks to their respective states. In response to this requirement, SPR forwarded an inventory of USTs to the State of Texas (Gray, 1986a). However, during the Environmental Survey, the Survey team identified one UST that should have been reported to the TWC pursuant to the mandatory notification provision of RCRA. It is a 3,000-gallon steel tank installed at the raw-water-intake structure. The tank was installed to receive oil from the oil/water separator in the event of an oil spill or leak on the intake structure. The tank does not represent an environmental risk. The tank had been installed only recently at the time of the Survey and should be in excellent condition.

4.2.2 Toxic and Chemical Materials

4.2.2.1 General Description of Pollution Sources/Controls

4.2.2.1.1 Toxics Management

At the time of the Environmental Survey, Big Hill was in the final stages of site construction. As a result, procedures covering the purchase and storage of toxic and chemical materials at the site were not yet completely established. Materials were being purchased on an "as needed" basis; however, according to site personnel, it is common practice to request and review Material Safety Data Sheets (MSDS) before materials are used at the site (Morris, 1987b). MSDS files for products in use at Big Hill are maintained. It is anticipated that formal purchase systems for toxic and chemical materials similar to that in use at Bryan Mound will be implemented at Big Hill when construction of the site is completed.

At the time of the Environmental Survey, toxic and chemical materials were being stored at several locations at Big Hill. These locations included the Warehouse, Construction Contractor's Laydown Yard, and the BPS Laydown Yard (see Figure 4-6). Small quantities of pesticides, cleaning agents, oils, solvents, and various other toxic and chemical materials are stored in the Warehouse. When these storage locations were inspected during the Environmental Survey, no deficiencies with respect to proper storage of the toxic and chemical materials were noted. However, in both the BPS Laydown Yard and the Construction Contractor's Laydown Yard, unprotected storage of toxic and chemical materials was observed. Outside the Flammable Storage Building in the BPS Laydown Yard, twelve 55-gallon drums of various oils (two of which were leaking), 2 drums of flammable solvent, and 10 drums of waste oils were placed directly on the ground, unprotected from adverse weather conditions in an area without an impervious floor or curbing to contain potential spills. Similarly, at the Frac Tank Area in the BPS Laydown Yard, forty 55-gallon drums of AFFF, 6 drums of waste oils (one of which was open and subject to overflow from rainwater), and 2 drums of waste solvents were stored out-of-doors and directly on the ground. A proper storage facility was also lacking in the Construction Contractor's Laydown Yard at Big Hill, where 30 drums of various oils, 5 drums of waste oils, 2 drums of kerosene, and thirty 1/2-gallon to 5-gallon containers of epoxy adhesives were stored. Therefore, in the event of a drum leak or rupture, spilled substances would contaminate surrounding soils and could be released into nearby surface waters. The storage of toxic and chemical materials at locations lacking effective spill-control measures has previously been identified during environmental audits conducted by the operating contractor environmental staff (Teerling, 1987c), an EPA inspection of the Weeks Island Site (Townsend, 1986), and a DOE-PMO Site

Management Appraisal at St. James Marine Terminal (Wagoner, 1987). Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous waste) drum storage areas, such measures are considered good management/operational practice. A request to install covered drum storage racks at all SPR sites was submitted to DOE by BPS but was not authorized (Teerling, 1987d). BPS is in the process of submitting similar requests to DOE to construct such facilities on a site-specific basis.

Big Hill relies upon the labels placed upon containers of toxic and chemical materials to inform workers of the potential hazards associated with these materials. BPS has also established formal procedures to comply with the requirements of the OSHA Hazard Communication Standard and similar requirements imposed by Texas and Louisiana (BPS, 1987b).

4.2.2.1.2 Tank Farm Facilities

Underground Storage Tanks

Three USTs are present at the Big Hill site (Gray, 1986a). None of these USTs are used to store wastes. For a complete discussion of the USTs at Big Hill, see Section 4.2.1.2.4.

Above-Ground Storage Tanks

There are four above-ground storage tanks at Big Hill used to store toxic and chemical materials:

1. An 840,000-gallon surge tank that is surrounded by a containment dike (a secondary containment measure in the event of a spill, i.e., overflow, tank rupture, etc.) sufficient to contain the contents of the tank (BPS, 1987g).
2. A 10,000-gallon oil recovery tank that is located on the brine pump pad and is used to hold oil that is skimmed from brine in the oil recovery pond. This tank is normally empty, and it is not provided with a secondary containment dike; however, any spills from the tank would drain back to the oil recovery pond.

3. A 500-gallon diesel tank at the raw-water-intake structure that is surrounded by a containment dike.
4. A 50-gallon diesel tank for the emergency generator at the raw-water-intake structure. The tank itself is not diked but a spill from the tank would drain to the oil/water separator for the raw-water-intake structure.

4.2.2.1.3 Spill Prevention, Control, and Countermeasures (SPCC) Plan

The Big Hill site will handle large volumes of crude oil and is located close to navigable waters. As a result, the requirements of the EPA Oil Pollution Prevention regulations (40 CFR 112) are particularly applicable to the site. In response to these requirements, Big Hill has prepared and implemented an SPCC Plan (BPS, 1987g) and a Spill Contingency Plan (BPS, 1987c). These documents contain listings of potential spill sources; type and quantity of material that would be released; personnel and equipment resources; and spill evaluation, support and response procedures.

Engineering controls have also been implemented at the site. Containment dikes that drain to sumps equipped with oil/water separators have been constructed at each cavern wellpad. An oil recovery pond has been built to remove oil that enters the brine system. A sump has been provided at the pig trap. Spills from the high-pressure pump pad or meter prover station would drain to a 65,000-barrel-capacity concrete pond.

An Emergency Response Team (ERT) has been organized at Big Hill. All ERT members receive 40 hours of training at the ERT Academy at Lamar University (BPS, 1987i), which includes training on oil-spill control and cleanup. Spill-control equipment is maintained at the site.

Formal monthly inspections of the site for deficiencies related to spill prevention and control are performed by the Big Hill Environmental Specialist (BPS, 1987g). The inspection report is forwarded to the Big Hill Site Manager for review and approval. SPR has established formal reporting requirements for oil spills of one or more barrels, or oil spills of any quantity on navigable waterways. Similar reports must be prepared for brine spills of any quantity leaving the site or five or more barrels on-site. For spills of hazardous substances, the reporting requirements established by EPA have been implemented. During CY 1986, no reportable oil or brine spills occurred at Big Hill (Teerling, 1987e).

4.2.2.1.4 Polychlorinated Biphenyls (PCBs)

It is the policy of SPR not to permit any equipment that contains fluids with a PCB concentration in excess of 5 parts per million (ppm) on any SPR site (BPS, 1987e). Due to this restriction, and because the Big Hill site was recently constructed, there are no PCB-containing materials at the site.

4.2.2.1.5 Pesticides

Pesticides (i.e., insecticides, herbicides, and rodenticides) are used at Big Hill and are applied both by site and contractor personnel. Restricted-use pesticides (i.e., pesticides that according to EPA must be applied only by a certified pesticide applicator or persons directly supervised by a certified pesticide applicator) are used only by contractor personnel who are licensed to handle such materials (Teerling, 1987f). The pesticides currently applied by contractor personnel are both restricted-use and nonrestricted-use pesticides and include Hubco 147 Rat and Mouse Bait, Maxforce Roach Control System, PT110 and PT250 (insecticides), and Dursban (insecticide).

Site personnel apply Malathion for mosquito control and Roundup for weed control. Roundup is used at the electrical substation, at site perimeter fencing, and on cavern pads. Written procedures governing the use of pesticides at Big Hill have not been established. Application records are not maintained. Site personnel indicated that pesticides are applied in accordance with the directions on the pesticide container labels.

The supply of the pesticides used at Big Hill is stored at the Warehouse. This location was inspected during the Environmental Survey and was found to be in an orderly condition, with no evidence of leaks or spills. Any mixing of pesticides required prior to application is conducted in the vicinity of the fuel station adjacent to the Warehouse.

In addition to the herbicides that are applied by site personnel at Big Hill, a pipeline crew stationed in Big Hill is responsible for spraying herbicides at road crossings and valve stations on both the Big Hill crude-oil pipeline to/from the Sunoco terminal and the brine discharge line. A commercial aerial spraying contractor is also used to spray herbicides (Tordon K and Esteron 99) along the entire length of these pipelines. This contractor meets all the requirements for aerial herbicide spraying mandated by the Texas Department of Agriculture (Whitmire, 1987).

4.2.2.1.6 Asbestos

There are no asbestos-containing materials at Big Hill, other than that associated with the asbestos-containing gaskets on the pipelines. SPR has established procedures for proper removal and disposal of these asbestos-containing gaskets during routine maintenance (BPS, 1986c). These procedures will be utilized at Big Hill until all asbestos-containing gaskets have been properly removed, disposed, and replaced with asbestos-free gaskets.

4.2.2.1.7 Chlorofluoroalkanes

About 225 pounds of chlorofluoroalkanes are used at Big Hill annually (Teerling, 1987h). These materials are used as refrigerants in air-conditioning units. As a group, the chlorofluoroalkanes are relatively volatile compounds, and potential environmental problems due to vapor emissions can result if they are not properly handled and stored. Essentially 100 percent of the chlorofluoroalkanes purchased by Big Hill in 1987 was CFC-22; this material is a gas at room temperature. CFC cylinders are stored indoors at Big Hill until needed. During the Environmental Survey, chlorofluoroalkanes appeared to be stored properly at Big Hill.

4.2.2.2 Findings and Observations

4.2.2.2.1 Category I

None.

4.2.2.2.2 Category II

None.

4.2.2.2.3 Category III

1. Inadequate Secondary Containment Measures. There is a potential for releases of oil, chemical materials, and wastes into the environment from drum storage areas lacking effective spill containment. Drums containing chemical products and waste materials are currently stored out-of-doors, unprotected from adverse weather conditions at locations lacking impervious flooring and curbing to contain spills. In the event of a drum leak or rupture, spilled substances would contaminate surrounding soils and could possibly be released into nearby surface waters. Deficiencies of this type were previously identified

during BPS environmental audits of other SPR sites, an EPA inspection of the Weeks Island site, and a DOE Site Management Appraisal. Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous waste) drum storage areas, such measures are considered good management/operational practices.

Deficient storage of chemical products and wastes noted by the Survey team at Big Hill include the following:

- Outside the Flammable Storage Building in the BPS Laydown Yard, twelve 55-gallon drums of various oils (two of which were leaking), 2 drums of flammable solvent, and 10 drums of waste oils were placed directly on the ground, unprotected from adverse weather conditions in an area without an impervious floor or curbing to contain potential spills.
- At the Frac Tank Area in the BPS Laydown Yard, forty 55-gallon drums of AFFF, 6 drums of waste oils (one of which was open and subject to overflow from rainwater), and 2 drums of waste solvents were stored out-of-doors and directly on the ground.
- In the Construction Contractor's Laydown Yard at Big Hill, 30 drums of various oils, 5 drums of waste oils, 2 drums of kerosene, and thirty 1/2-gallon to 5-gallon containers of epoxy adhesives were stored out-of-doors, unprotected from adverse weather conditions in an area without an impervious floor and curbing to contain potential spills.

4.2.2.2.4 Category IV

None.

4.2.3 Radiation

There are no radioactive sources or materials at Big Hill. The site does not have any gamma-ray densitometers or sulfur analyzers. No logging sources have been lost on-site.

4.2.4 Quality Assurance

4.2.4.1 General Description of Data Handling Procedures

The quality assurance aspects of the environmental monitoring program at the Big Hill site are governed by quality assurance procedures developed by BPS (Teerling, 1986c). The requirements of the procedures are summarized in Section 3.2.4.1. The environmental monitoring that is required at Big Hill includes discharge monitoring to support the National Pollutant Discharge Elimination System Permit issued by the EPA and the Texas Water Commission Discharge Permit. These permits regulate discharges from the brine line, the hydroclone and blowdown at the raw-water-intake structure, the sewage treatment plant, and storm-water collection areas such as cavern pads and pump pads. The water monitoring at Big Hill is discussed in more detail in Section 4.1.2.3.

At the time of the on-site portion of the Environmental Survey, the analytical laboratory at the Big Hill site was not fully operational. The laboratory was set up for pH, conductivity, colorimetry, and specific gravity; all other analyses were being performed by a commercial laboratory in Port Arthur, Texas (Chemtex, Inc.). The Big Hill laboratory maintains bound sample and calibration logbooks. The Survey reviewed the logbooks and other records related to analyses that had been performed at the Big Hill laboratory. Laboratory practices were observed to be consistent with the requirements of the BPS Environmental Program and Procedures Manual (Teerling, 1986c).

Little data were available for review because the site had only been collecting samples for a period of about 2 months, but the Survey team reviewed the available internal quality control records and did not observe any deficiencies or unacceptable results.

At the time of the on-site portion of the Survey, the laboratory had not been in operation sufficiently long to have participated in any interlaboratory comparison programs. There are plans for such participation in EPA and BPS administered programs in the future.

The Survey team observed brine-line sampling at one location. No other sampling was conducted while the Survey team was on-site. The sampling was performed by the Field Chemist. Prior to sample collection, the sample line was flushed and the sample bottle rinsed. The Survey team did

not observe any deficiencies that would be expected to compromise the validity of the data. However, there are no written procedures for the collection of water samples. The Field Chemist carried a small pocket notebook to record sampling information, which was later transferred to the sample logbook. The Field Chemist stated that there are plans to institute a field sampling logbook. All sample bottles were labeled with the sample number, date, and time of collection, and the sampler's initials. Chain-of-custody forms are used for all samples sent off-site. The Survey team reviewed the sample custody files and found them to be complete.

When sending samples off-site to Chemtex, Inc., for analysis, Big Hill requests duplicate and spiked samples for oil and grease and for total organic carbon. These data are submitted to Big Hill with the sample analysis data. In addition, Chemtex submits to Big Hill the results of their internal quality control data and reports of their performance in the EPA's Discharge Monitoring Report Quality Assurance Program. The site Field Chemist reviews all analytical data and supporting quality assurance data. The Survey team reviewed the quality assurance data supplied to the site and observed no deficiencies.

4.2.4.2 Findings and Observations

4.2.4.2.1 Category I

None.

4.2.4.2.2 Category II

None.

4.2.4.2.3 Category III

None.

4.2.4.2.4 Category IV

1. Lack of Written Sampling Procedures. At the time of the on-site Survey, Big Hill did not have complete written procedures for the field collection of water samples for NPDES monitoring. The Environmental Survey team observed sampling of the brine line and did not note any practices that would be likely to compromise the validity of the data. Personnel have received training in sample collection techniques and the training has been documented; however,

there is no documentation that describes the content of the training sessions. Written procedures would provide documentation that proper sampling methodologies are being used in a consistent manner by all samplers, and would help support the validity of the data. In addition, the use of written procedures for training new or substitute samplers would help ensure that there would be no change in sampling methodology with a change in personnel.

PRELIMINARY

4.2.5 Inactive Waste Sites and Releases

4.2.5.1 Background Information

The Survey team investigated each of the SPR facilities to identify inactive waste sites and releases of hazardous materials that are sources or potential sources of environmental contamination. Inactive sites and hazardous materials releases may either be subject to various environmental regulations or may not be addressed by the environmental regulatory framework. The Survey team identified and inventoried inactive sites and hazardous materials releases that may cause environmental problems, regardless of the regulatory status of the sites or materials involved. Document reviews, personal interviews, and brief site visits are the basis for the observations and findings described in this section.

Many of the inactive waste sites and releases identified by the Survey team may be subject, via the Federal facilities provision, to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and associated Executive Orders. Therefore, DOE Order 5480.14 (under revision) was issued on April 26, 1985 to implement DOE's CERCLA Program, which is intended to define actions and to identify and evaluate inactive hazardous waste sites on DOE installations, and to effect remedial actions, where warranted. The first two phases of a five-phased program prescribed under DOE Order 5480.14 were completed before the Survey team visited the SPR sites. A report was prepared under each of these two phases, the Phase I CERCLA Report: Installation Assessment, April 1986 (BPS, 1986b), and the Phase II CERCLA Report: Confirmation, April 1987 (BPS, 1987f). According to DOE 5480.14, Phase I was intended to "evaluate site history and records, and to locate and identify those inactive hazardous waste disposal sites that may pose a risk to health, safety, and the environment as a result of migration of hazardous substances." Phase II was described by DOE 5480.14 as an effort to "quantify, by preliminary and comprehensive environmental survey, the presence or absence of hazardous substances that may pose a risk to health, safety, and the environment." The Survey team used the Phase I and II CERCLA Reports to aid in identifying and evaluating inactive sites and releases.

Since passage of the Superfund Amendments and Reauthorization Act (SARA) of 1986, DOE has revised its CERCLA program and DOE Order 5480.14 to implement the new SARA requirements. DOE has replaced the five-phased program and adopted the Environmental Protection Agency (EPA) program as outlined in the National Contingency Plan. DOE also issued guidance to its facilities on how to use data collected under its old CERCLA program to meet requirements of SARA. Conversion of Phase I CERCLA Reports (i.e., Installation Assessments) to Preliminary Assessments (i.e., the first step under the EPA program) was to be completed by April 1988.

This section provides an overview of inactive waste sites and releases at Big Hill. Information was obtained from several sources, including SPR personnel and records and the Phase I and Phase II CERCLA Reports.

4.2.5.2 General Description of Pollution Sources/Controls

4.2.5.2.1 Former Amoco Facilities

Amoco operated an oil-producing facility on-site prior to DOE acquisition. Included with this facility were several tanks, a brine disposal well, and a mud pit, all of which were located at the southeast part of the site. An SPR warehouse was later constructed over the tank area. No visible soil contamination was identified during construction. The mud pit, which was used for mixing drilling muds, was cleaned out and graded by Amoco. The brine disposal well was located in the vicinity of the site entrance and was used for brine disposal for the oil wells. It was later plugged by Amoco and abandoned. Other areas of the site where activity occurred prior to DOE acquisition include a remnant diked area that was identified from an aerial photograph. The area was located near the southwest portion of the site and has since been backfilled and graded. The purpose of this diked area is unknown. Aerial photographs also showed cleared areas to the north of the diked area. These areas have also been backfilled and graded. The purpose of these cleared areas is also not known. There was no evidence of hazardous wastes disposed of at these areas (BPS, 1986b).

4.2.5.2.2 Contamination of Leaching Wells

Several of the Big Hill leaching wells were found to be contaminated after the wells were completed. Unusually colored and high-viscosity fluids were found in wells that were drilled by Drillers, Inc. This company drilled Wells 101A-105B and 111A-114B for a total of 18 wells.

All of the wells (i.e., 28 wells) at Big Hill were subsequently sampled and analyzed for priority pollutants. Low levels of organic priority pollutants were detected in most of the wells. The compounds were benzene, toluene, ethylbenzene, di-n-butyl phthalate, bis(2-ethylhexyl)phthalate, phenol, methylene chloride, 1,2-dichloroethane, vinyl chloride, isophorone, and n-nitrosodiphenylamine (BPS, 1987f). However, only a few organic compounds were measured with maximum concentrations greater than 0.1 ppm: benzene (0.320 ppm at Wells 108A and 114B), toluene (0.990 ppm at Well 114B), ethylbenzene (0.110 ppm at Well 114B), and 1,2-dichloroethane (1.800 ppm at Well 113B).

Inorganic compounds with maximum concentrations exceeding 0.1 ppm included lead (265 ppm at Well 103A), cadmium (1.0 ppm at Well 101B), mercury (4.8 ppm at Well 111A), cyanide (480 ppm at Well 114A), antimony (12.8 ppm at Well 111A), nickel (4.06 ppm at Well 101A), thallium (6.8 ppm at Well 101A), and barium (40 ppm at Well 103B) (BPS, 1987f). Lead concentrations exceeding 1 mg/L were found in 26 wells, and cadmium levels in excess of 1 mg/L were found in 3 wells. Antimony, nickel, and thallium were found in every well, with most levels exceeding 1 mg/L. Barium was found in several of the wells (BPS, 1987f).

After reaching an agreement with the EPA Region VI and the Texas Water Commission (EPA, 1987b; TWC, 1987), the site flushed 23 of the 28 wells with clean brine and discharged the contaminated brine (i.e., low-level contamination) to the Gulf of Mexico through Big Hill's brine disposal system. It was also agreed that contaminated brine from the other five wells (i.e., 103A, 108B, 111A, 113B, and 114A) would be flushed and discharged to on-site holding tanks for further chemical analysis. As of the on-site Survey, Wells 103A and 108B had been flushed to holding tanks, sampled and analyzed, and found to be nonhazardous by the EP toxicity test. The remaining three wells (i.e., 111A, 113B, and 114A) will be flushed when the wellpads are completed in 1988. Pending the results from further analysis, the brine from all five wells will be injected into the Trinity Products, Inc., oilfield waste injection well, which is off-site.

4.2.5.2.3 Inactive Mud Disposal Ponds

A series of three ponds was constructed at the west side of Big Hill for the disposal of saltwater cuttings and drilling muds (Figure 4-7). Chrome lignosulfonate was used as a mud additive for several of the wells; thus chromium was likely to be found in the mud ponds. The ponds were therefore sampled and analyzed for the EP toxicity constituents. Table 4-5 presents the data for this analysis. None of the samples exceeded the EP toxicity regulatory limits. (The highest EP toxicity measurement for chromium was 0.069 mg/L. The EP toxicity regulatory limit for chromium is 5 mg/L.) The three ponds were later solidified and capped in accordance with Railroad Commission of Texas Rule 8.

There is also a freshwater mud disposal pond located northwest of the saltwater mud disposal ponds (Figure 4-7). Site personnel suggested during the CERCLA Phase I investigation that this freshwater disposal pond could have been contaminated with saltwater cuttings containing chrome lignosulfonate. As a result, the pond was sampled and analyzed for EP toxicity constituents. Table 4-6 presents the data from the EP toxicity analysis. None of the samples analyzed from this pond exceeded the EP toxicity regulatory limits (chromium was not detected in the samples analyzed). The pond was later capped in accordance with Railroad Commission of Texas Rule 8.

FIGURE 4-7

LOCATION OF INACTIVE WASTE SITES AT BIG HILL
STRATEGIC PETROLEUM RESERVE

TABLE 4-5

**EP TOXICITY DATA FOR BIG HILL
SALTWATER MUD DISPOSAL PONDS
STRATEGIC PETROLEUM RESERVE**

Constituent	EP Toxicity Mean Concentration			EP Toxicity Regulatory Limits (mg/L)
	Pond 1 (mg/L)	Pond 2 (mg/L)	Pond 3 (mg/L)	
Arsenic	0.018	0.042	0.040	5
Cadmium	0.021	0.017	0.027	1
Chromium	0.065	0.066	0.069	5
Lead	1.15	1.62	0.82	5
Mercury	0.0027	0.002	N/A	0.2
Selenium	0.021	0.011	0.010	1
Silver	0.065	0.043	0.035	5

Source: BPS, 1987f.

Pond 1: North Pond; Pond 2: Middle Pond; Pond 3: South Pond (see Figure 4-7)

TABLE 4-6

EP TOXICITY DATA FOR BIG HILL
FRESHWATER MUD DISPOSAL POND
STRATEGIC PETROLEUM RESERVE

Constituent	EP Toxicity Mean Concentration (mg/L)	EP Toxicity Regulatory Limits (mg/L)
Arsenic	0.0021	5
Barium	0.40	100
Cadmium	0.007	1
Chromium	N/D	5
Lead	0.078	5
Mercury	0.0021	0.2
Selenium	0.007	1
Silver	0.011	5

Source: BPS, 1987f.

N/D: none detected

4.2.5.2.4 Oil and Brine Spills

The nature of SPR activities at Big Hill creates the potential for crude oil and brine spills. A review of Big Hill environmental files, including Spill Incident Reports and Environmental Action Reports, shows a few minor spills of this nature. Adequate spill responses were reportedly initiated. No spills of regulatory reportable quantities have occurred. A leak in the anhydrite pond is addressed in Section 4.1.3.2.1, Brine Ponds.

4.2.5.3 Findings and Observations

4.2.5.3.1 Category I

None.

4.2.5.3.2 Category II

None.

4.2.5.3.3 Category III

None.

4.2.5.3.4 Category IV

None.

5.0 SULPHUR MINES

The Sulphur Mines site is located in Calcasieu Parish, Louisiana, about 2 miles west of Sulphur, Louisiana, and 12 miles west of Lake Charles, Louisiana (Figure 5-1). The site is divided into a quadrangular primary area and a figure-eight-shaped wellpad area (Figure 5-2). The wellpad area is bordered on the west, northwest, and northeast by water bodies. Most of these bodies of water are interconnected and drained by one creek flowing eastward from the site. A floodwater canal is located 1 mile east of the site. Changes in elevation throughout the site are minor, with most of the site 15 to 20 feet above sea level. The site proper is normally dry except in the spring season or during heavy rains, when high waters sometimes flood portions of it. The lowest elevations are over the center of the dome, where subsidence has occurred as a result of prior sulfur-mining activity. Much of the surrounding area is covered with a mixed pine/hardwood forest.

The land use in the vicinity of the Sulphur Mines dome is devoted entirely to oil and gas production, and brining operations. Sulfur mining was a major activity here until 1924; very little sulfur has been mined since. There are no agricultural uses of the land, and the nearest residences are 2 miles away in the city of Sulphur. However, a housing development is in progress on property adjacent to the eastern boundary of Sulphur Mines property.

The 1984 estimated population for Calcasieu Parish was 174,961 (USBC, 1986).

The site, with five existing caverns, was acquired in 1979. The capacity of the existing caverns is 26 million barrels. Development and fill with crude oil was completed in 1983. The site is currently in an operational standby mode (DOE, 1987).

5.1 Media-Specific Survey Findings

The discussions in this section pertain to existing or potential environmental problems in the air, surface water, and groundwater/soil media. The discussions include a summary of the available background environmental information related to each medium, a description of the sources of pollution and their control techniques, a review of the environmental monitoring program specific to each medium, and a categorization and explanation of the environmental problems found by the Survey team related to each medium.

FIGURE 5-1

SULPHUR MINES, LOUISIANA, SITE LOCATION
STRATEGIC PETROLEUM RESERVE

FIGURE 5-2

VICINITY OF SULPHUR MINES STRATEGIC PETROLEUM RESERVE

5.1.1 Air

5.1.1.1 Background Environmental Information

The air portion of the Environmental Survey of the Sulphur Mines site is designed to address existing and potential environmental impacts associated with releases of contaminants to the atmosphere, and includes a critical evaluation of air pollution sources and controls, and compliance with air pollution regulations. Adherence to established environmental procedures is evaluated from the standpoint of environmental problems or risks. Principal regulations relating to air emissions used as guidance during the Survey include

- The Clean Air Act (CAA) and Amendments
- Federal Regulations, including
 - National Ambient Air Quality Standards (NAAQS) (40 CFR 50)
 - Standards of Performance for New Stationary Sources (40 CFR 60)
 - National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61)
- Louisiana Air Quality Regulations

Sulphur Mines is located in Calcasieu Parish, Louisiana, which is part of the Southern Louisiana-Southeast Texas Interstate Air Quality Control Region (AQCR) No. 106 (40 CFR 81.53, July 1, 1987).

The national ambient air quality standards (see Table 3-1) have been incorporated into Louisiana air pollution control regulations and are enforced throughout the state. The attainment status of the Calcasieu Parish portion of AQCR No. 106 is described (40 CFR 81.319, July 1, 1987) as follows:

Parameter	Status
Total Suspended Particulates	Better than National Standards
Sulfur Dioxide	Better than National Standards
Ozone	Does not meet Primary Standards
Carbon Monoxide	Cannot be Classified or Better than National Standards
Nitrogen Dioxide	Cannot be Classified or Better than National Standards

The status of other criteria pollutants, including PM-10 particulate matter and lead, has not been published.

Wind data recorded at the Lake Charles Municipal Airport, which is about 15 miles southeast of Sulphur Mines, are representative of air-flow patterns at Sulphur Mines. Characteristic winds for stations near the SPR sites are discussed in Section 2.1.

5.1.1.2 General Description of Pollution Sources/Controls

Facilities at Sulphur Mines with potential for emissions to the atmosphere were addressed in a Certificate of Approval (No. 1042) issued by the Louisiana Air Control Commission (LACC, 1978a). The sources addressed in the Certificate and the emission rate limitations are as follows:

Source of VOC Emissions	Emission Rate Limits (pounds per hour)
Slop-Oil Tank	4.2
Brine Ponds	11.8

The locations of these sources are shown in Figure 5-3.

5.1.1.2.1 Slop-Oil Tank

A 2,700-gallon underground tank receives predominantly storm water that is contaminated with crude oil from the pump and meter/prover pads (Welsh, 1984). When the tank is full, a vacuum truck removes the oil/water mixture and transports it to West Hackberry. VOC emissions result from oil throughput and tank breathing losses. These emissions will occur during crude-oil-transfer exercises, if crude-oil spills occur at the pump and meter/prover pads.

5.1.1.2.2 Brine Ponds

During static storage, the cavern volume tends to decrease because of salt movement (cavern creep), which results in increased pressures on the crude oil and brine contained within the cavern. Regular bleeding of brine is required to relieve pressure. Brine removed from a full cavern normally contains small amounts of dissolved VOCs that vaporize once the pressure is released in the brine ponds. VOC emissions from the brine ponds would continue during crude-oil withdrawal because cavern creep would still require brine bleeding in those caverns not being drawn down.

FIGURE 5-3

LOCATION OF AIR-EMISSION SOURCES AT SULPHUR MINES
STRATEGIC PETROLEUM RESERVE

5.1.1.2.3 Valve Stems and Pump Seals

Although the Certificate of Approval (COA) does not discuss valve stems and pump seals as potential sources of VOC emissions, both are addressed in an Emission Inventory Questionnaire (EIQ) prepared by the Site Operating contractor and submitted to the Louisiana Environmental Control Commission by the DOE on July 1, 1984 (Welsh, 1984). During the envisioned one-time oil withdrawal, VOC emissions are anticipated from 17 valve stems at 3 wellheads and at the meter pad. The COA does not specify requirements for monitoring or control of VOC emissions from valve stems.

Withdrawal of crude oil will generally be accomplished using brine and fresh-water pumps to displace the oil from the caverns. However, the crude-oil pumps may be required at some point during drawdown. Thus, because the crude-oil pumps may not be used during the entire drawdown, VOC emissions from the pump seals should not be continuous.

5.1.1.2.4 Plant Road Dust

Although the Permit does not require control of unpaved road dust, Sulphur Mines uses applications of calcium chloride at 90-day intervals in an effort to minimize dust emissions.

5.1.1.2.5 Space Heating

Space heating at Sulphur Mines is provided by electricity.

5.1.1.3 Environmental Monitoring

5.1.1.3.1 Monitoring of Ambient Air Quality

A monitoring program was initiated by the Site Contractor at Sulphur Mines on October 1, 1982, to determine baseline ambient-air-quality. The program continued through September 30, 1983 (York, 1984). Parameters monitored during that period were total suspended particulates, ozone, and nonmethane hydrocarbons. The total suspended particulate concentrations met both primary and secondary annual and 24-hour standards, whereas ozone exceeded the hourly standard (which is not uncommon in an AQCR designated as a nonattainment area for ozone). Although there are no current air-quality standards for nonmethane hydrocarbons (volatile organic compounds), a maximum hourly average of 11.5 ppm was measured at Sulphur Mines, which is about 2 to 10 times higher than maximum values at the other sites (York, 1984).

5.1.1.3.2 Emission Monitoring

In Louisiana, the Department of Environmental Quality (DEQ), Air Quality Division (AQD), can require or request submission of an Emissions Inventory Questionnaire (EIQ) for a new or expanded facility, or for modifications that result in significant change in emissions (AQD Regulation 17.12).

After the caverns were filled with crude oil and placed in standby status, an EIQ, which included calculated estimates of VOC emissions, was submitted to the Louisiana DEQ (Welsh, 1984). The EIQ deleted VOC emissions resulting from cavern-fill operations (which have been completed); reflected potential VOC emission levels from the slop-oil tanks, brine pond, and valve stems during static storage and during crude-oil withdrawal; and deleted emissions from subsequent cavern refilling operations. Such operations will not occur because Sulphur Mines, designed for one fill cycle, will be decommissioned after the crude oil is moved to expanded facilities at Big Hill and Bayou Choctaw. The VOC emissions projected in the EIQ are shown in Table 5-1. None of these emissions exceed the Permit limits. Periodic monitoring of sources of fugitive VOC emissions is not required as a Permit condition.

5.1.1.4 Findings and Observations

5.1.1.4.1 Category I

None.

5.1.1.4.2 Category II

None.

5.1.1.4.3 Category III

None.

5.1.1.4.4 Category IV

None.

TABLE 5-1

**PROJECTED EMISSIONS OF VOLATILE ORGANIC COMPOUNDS - SULPHUR MINES SITE
STRATEGIC PETROLEUM RESERVE**

Source	Withdrawal and Static Modes			Static Mode			Withdrawal Mode		
	Average lb/hr ⁽¹⁾	Maximum lb/hr	Annual tpy ⁽²⁾	Average lb/hr ⁽³⁾	Maximum lb/hr	Annual tpy ⁽²⁾	Average lb/hr ⁽¹⁾	Maximum lb/hr	Annual tpy ⁽²⁾
Stop-Oil Tank (1-78) ⁽³⁾	0.0412	0.0412	0.1805	-	-	-	-	-	-
Brine Pond (2-78) ⁽⁴⁾	-	-	-	0.0100	3.640	0.0437	0.0072	3.640	0.0314
Valve Stems ⁽⁵⁾	-	-	-	-	-	-	0.0545	0.0765	0.2387

Source: Welsh, 1984.

(1) lb/hr = pound per hour

(2) tpy = ton per year

(3) Based on equations given in EPA Report AP-42.

(4) Based on data from Bryan Mound brine pond.

(5) Based on data in EPA Report AP-40.

5.1.2 Surface Water

5.1.2.1 Background Environmental Information

5.1.2.1.1 Surface-Water Bodies in the Area

The surface-water bodies in the vicinity of the Sulphur Mines site include several man-made, fresh-water reservoirs and ponds (including the subsidence area north and east of the storage caverns); the Sabine River Diversion Canal (SRDC), approximately 1.5 miles north of the site; Canal No. 5 of the SRDC System, approximately 1 mile east of the site; the Intracoastal Waterway (ICW), approximately 14 miles south of the site; and Brimstone Ditch, Bayoud'Inde, and the Calcasieu River. The relationship of these surface-water bodies to the site is shown in Figure 5-4:

5.1.2.1.2 Sources of Water Used at the Site

The raw water used for oil withdrawal operations at Sulphur Mines comes from the intake structure on Canal No. 5, east of the site. Well water is used for all other uses on-site except for drinking, cooking, and hand washing. Bottled water is supplied for these purposes (Chaterlain and Roberts, 1987).

5.1.2.1.3 Flood Plain

The Sulphur Mines SPR Site is subject to local flooding. Infiltration of surface water is very slow due to the low permeability of the surficial clayey soils. Drainage is further impeded by levees and spoil piles formed by dredging, and by the low relief in the area. During periods of heavy rainfall, considerable flooding occurs in the site facilities area.

The 100-year flood elevation at the site has been estimated to be ± 18 feet National Geodetic Vertical Datum of 1929 (Whiting, 1981). Elevations shown on the construction drawings indicate that the facilities have been built with finished floors at elevation ± 19 , and grades around structures raised to elevation ± 18.5 . In essence, this provides for the protection of the site facilities from the 100-year flood. However, in the event of a flood of this magnitude, large portions of the site would be under water, and it is probable that there would be no easy access to the site.

During the May 16, 1980 storm, 15.67 inches of rainfall fell at the Lake Charles airport during a 25-hour period. As a result of this rainfall, the entire area was inundated to a depth of approximately 2 to 3 feet. Some high spots and roads at the site were above water. However, the

FIGURE 5-4

SURFACE WATERS IN THE VICINITY OF SULPHUR MINES STRATEGIC PETROLEUM RESERVE

site was essentially inaccessible, and operations at the site were stopped for approximately 2 days. The subsidence area (discussed in Section 5.1.3.1) is kept dewatered to prevent inundation of pipelines belonging to adjacent facilities. This requires lifting the water that accumulates within this depression approximately 10 feet so that it can flow off-site with other surface-water drainage. The pumps used to accomplish this are located on the north side of the road between Cavern Wellpads 2 and 4 (Point C in Figure 5-5).

5.1.2.2 General Description of Pollution Sources/Controls

5.1.2.2.1 Water Uses at Site

Unlike some SPR sites, water is not used nor has it been used for leaching at Sulphur Mines. The storage caverns at this site were in existence when the site was purchased. Water from the intake structure on Canal No. 5 east of the site is used for oil withdrawal operations. At the time of the on-site Survey, the caverns at Sulphur Mines were filled to capacity and the site was in a static mode (i.e., oil was not being received nor delivered and no leaching was occurring). This water can also be used as an emergency fire water supply. A water well on-site provides water for fire protection, brine pump seal flushing, toilet flushing, and wash-down hose connections. Bottled water is provided for both drinking and hand washing off-site.

The bearing seals on the brine pumps must be continually flushed with fresh water to prevent their being damaged (eroded) by these materials in the brine. This treatment consists of activated carbon filtration and zeolite softening. When water containing calcium and magnesium hardness passes through a zeolite softener, the calcium and magnesium become attached to the particles of exchange material and are replaced by an equivalent amount of sodium in solution. After a period of time, the exchange bed becomes exhausted (i.e., loses its ability to remove hardness from the water). It then must be regenerated by passing a solution of salt (sodium chloride) through the softener. During this regeneration operation, sodium is replaced onto the particles of the exchange material, and the capacity for removing hardness is thus restored. The calcium and magnesium accumulated during the previous softening run are discharged in the spent salt solution from this regeneration. Spent salt solution must be rinsed from the exchange bed before the unit can be returned to service (i.e., failure to rinse a bed sufficiently may contaminate the water system with chloride, calcium, and magnesium). At the time of the Survey, Sulphur Mines did not have a permit for the periodic discharge of spent salt solution and rinse water to the ditch east of the sewage treatment plant. The ditch receives these wastes as well as the effluent from the sewage treatment plant.

FIGURE 5-5

SURFACE-WATER SAMPLING LOCATIONS AT SULPHUR MINES STRATEGIC PETROLEUM RESERVE

The fire protection system is supplied with water from the well. Sulphur Mines, as do the other SPR sites, uses Aqueous Film Forming Foam (AFFF) to improve the fire-extinguishing capabilities of the system. This material is effective in covering and extinguishing hydrocarbon liquid-based fires. AFFF is obtained from a variety of suppliers through competitive bids. However, all the materials have similar characteristics of high biochemical and chemical oxygen demand (BOD and COD); are mostly biodegradable; contain 5 percent or less fluorocarbon surfactants, which are not biodegradable; and exhibit varying degrees of aquatic toxicity, although they are classified as practically nontoxic in the manufacturer's literature because the oral LD₅₀ for rats is greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered.) The oxygen depletion due to the high BOD and COD, coupled with the aquatic toxicity, could result in short-term environmental degradation if this material were released to adjacent surface water. The "as purchased" concentrate is mixed with water to provide a 3 percent solution to be sprayed on the fire. The fire monitors (water cannons) at the cavern pads use eductors to siphon the concentrate directly from drums placed adjacent to the monitor. The mobile fire-fighting equipment is also capable of using AFFF. SPR procedures call for annual testing of the fire protection systems and training of personnel. SPR has estimated that 16,267 gallons of 3 percent AFFF Solution would be generated annually in training and testing exercises at Sulphur Mines. Because the AFFF is biodegradable, the sewage treatment plant could treat the waste; however, the annual capacity of the existing systems for treating AFFF is only 456 gallons. In addition, while the dikes at the cavern wellpads would contain the foam used in fire-fighting or training exercises at those locations, there is no collection system in place at the pump pads. SPR has temporarily suspended testing and training requirements until the disposal problem has been resolved. At the time of the on-site portion of the Survey, SPR was continuing dialogue with the state and investigating disposal options. Subsequent to the on-site portion of the Survey, the Louisiana Department of Natural Resources granted permission for the disposal of AFFF into SPR's saltwater disposal wells (Welsh, 1988). A finding relating to a problem with disposal of this material is presented in Section 5.1.2.4.3.

5.1.2.2.2 Brine Disposal

Brine from the caverns, during filling operations, is delivered to the brine pond for insoluble material to settle out and any entrapped oil to float to the surface. The recovered oil is reinjected back into the system. The brine is then pumped to the four DOE-owned injection wells, located approximately 1-1/2 miles southwest of the site along U.S. Highway 90. If the salinity of the brine is too low (specific gravity < 1.14), injecting it into the wells will cause the clay in the formation to swell and thus plug the formation. When brine in the ponds is lower than 1.14 specific gravity, it is reinjected back into

the cavern, or taken by truck to the West Hackberry brine pond for disposal. If the salinity is lower than three parts per thousand, the water in the pond can be discharged into the site drainage ditches, the same as is done with the storm water that accumulates on the cavern wellpads.

At the time of the on-site Survey, the brine ponds were filled with fresh water from the Sabine River Diversion Canal System (Canal No. 5). This fresh water was being made available to provide an emergency fire protection supply while the fire water tank was being renovated.

5.1.2.2.3 Sanitary Sewage

The sanitary sewage at Sulphur Mines is treated in an extended aeration, activated sludge, package sewage treatment plant located east of the Motor Control Center. This unit has a rated capacity of 1,500 gpd. Present loading from Sulphur Mines is on the order of 400 to 500 gpd. The effluent flows to a sand filter for removal of any suspended solids that do not settle out in the clarification section of the treatment plant. The solids that collect on the surface of the filter are scraped off into plastic bags and put into the BFI dumpster for disposal at a sanitary landfill. Because of the system's small size and low flow rate, it is susceptible to upsets from cleaning solution being dumped into the sinks and toilets. Cleaning personnel have been cautioned to avoid doing this, and the cleaning agents that they use have been closely regulated by the site.

5.1.2.2.4 Storm Water

Storm water from Cavern Pads 2 and 6 is drained into the subsidence area and is lifted from there by pumps into the site surface drainage. The surface drainage at the site is generally poor. Runoff collects in depressions and percolates slowly through the surficial soils. Although drainage patterns are complex and poorly defined, there is a general clockwise flow pattern around the dome, with the surface drainage exiting the site at the southeast corner through Crystal Creek to Bayou d'Inde (Whiting, 1981). Those areas (such as the cavern wellpads and pump pad) that have the greatest potential for spilling oil or brine are diked, and the storm water discharges through an oil/water separator. The oil/water separators at Sulphur Mines are operated in a batch mode, which can be described as follows. When a storm event occurs, the water contained in the dike is analyzed, and if it meets the discharge limits (Section 5.1.2.3.1), it is allowed to be discharged. If the water does not meet discharge limits, appropriate action is taken. Skimming oil from the water in the dike prior to discharge, to reduce the load on the oil/water separator, or removing the water to the brine pond, if it has a high salinity, are examples of actions that might be taken.

The meter prover pad does not discharge through an oil/water separator. If no oil is present, a drain valve is simply opened to allow the accumulated water to drain off the pad and flow off-site. If oil is present, the water is drained to the slop-oil tank where it is picked up by a vacuum truck and taken to the slop oil tank at West Hackberry for disposal.

Cavern Pad 2 has been built on a large layer of shells used as fill material. It sits on the edge of the subsidence area. The site has determined that storm water leaks from Pad 2 into the subsidence area. The leaking section is being repaired under Work Order 65708A900.

5.1.2.3 Environmental Monitoring Program

5.1.2.3.1 NPDES Monitoring

The discharges from Sulphur Mines are regulated under the terms of National Pollutant Discharge Elimination System (NPDES) Permit No. LA0055786 issued by the U.S. Environmental Protection Agency (EPA) on April 12, 1980. This permit expired April 11, 1985. A letter in the files from EPA dated April 4, 1985, acknowledges receipt of the permit renewal application from the SPR and directs the SPR to continue operating under the existing permit until a new permit is issued. Correspondence in the SPR files indicates that application for a state issued discharge permit was also made to the state on March 19, 1985. The site is complying with the terms of the expired NPDES permit until a renewal is issued.

The permitted NPDES outfalls are listed in Table 5-2 and their locations shown in Figure 5-5. The parameters to be measured, their limits, and the frequency with which they are to be sampled are given in Table 5-3. Although there are no permit requirements, regarding salinity in the storm-water discharge, Sulphur Mines analyzes the storm water for this parameter. If the salinity is greater than 3 parts per thousand, the storm water is allowed to accumulate until the salinity is lower or until the water could be taken by vacuum truck to West Hackberry for disposal.

There were no exceedances of the limits in any of the 507 NPDES analyses performed in 1986 (BPS, 1987h).

5.1.2.3.2 Surface-Water Monitoring

Although there are no permit requirements to do surface-water monitoring, Sulphur Mines takes samples of the waters adjacent to the site to monitor the effects of site operations on the environment. The locations of these samples are also listed in Table 5-2 and shown in Figure 5-5.

TABLE 5-2

WATER SAMPLING LOCATIONS
SULPHUR MINES SITE
STRATEGIC PETROLEUM RESERVE

NPDES Discharge Monitoring Stations	
001	Storm-Water Runoff from Well Pad 4
002	Storm-Water Runoff from Pump Pad
003	Storm-Water Runoff from Well Pad 2
004	Discharge from Sewage Treatment Plant
005	Storm-Water Runoff from Well Pad 7
006	Storm-Water Runoff from Well Pad 6

Water Quality Monitoring Stations	
A	Drainage Ditch at Northeast Corner of Primary Site
B	Creek North of Primary Site
C	Subsidence Area (Pump)
D	Impoundment North of Cavern 6
E	Impoundment West of Cavern 7
F	Intake Structure
G	Subsidence Area

Source: BPS, 1987h.

TABLE 5-3

**DISCHARGE MONITORING REQUIREMENTS AND EFFLUENT LIMITATIONS
SULPHUR MINES SITE
STRATEGIC PETROLEUM RESERVE**

Outfall	Parameter	Minimum	Daily Average	Daily Maximum	Measurement Frequency	Sample Type
001-003	Flow	N/A	Report	Report	1/week (1)	Instantaneous
005-006	Oil and Grease	N/A	N/A	15 mg/L	1/week (1)	Grab
Storm-Water Runoff	pH	6.0 S.U.	N/A	9.0 S.U.	1/week (1)	Grab
004	Flow		1,500 GPD	1,500 GPD	1/week	Instantaneous
Sewage Treatment Effluent	Biochemical Oxygen Demand		30 mg/L	45 mg/L	1/week	Grab
	Total Suspended Solids		30 mg/L	45 mg/L	1/week	Grab
	pH	6.0 S.U.	N/A	9.0 S.U.	1/week	Grab

Source: NPDES Permit LA0055786.

(1) When discharge occurs
S.U. Standard Units

Letters are used to designate the surface-water sampling locations as opposed to the NPDES sampling locations, which are identified by their numbers. Parameters measured were pH, salinity, total suspended solids, temperature, oil and grease, and dissolved oxygen. The pH ranged from 4.9 to 9.8 S.U. with a median of 7.3 S.U.; salinity averaged 1.3 ppt with a range of nondetectable to 3.5 ppt. Total suspended solids, averaged 26.1 mg/L and ranged from 2.3 to 364.0 mg/L. Temperature ranged between 15°C and 31°C with an average of 23°C. Oil and grease were below the detectable limits of 5 mg/L in all samples. Dissolved oxygen (DO) was only run at Station A, a relatively stagnant drainage ditch that receives the sewage treatment plant effluent. DO values ranged from 3.6 to 15.0 mg/L and averaged 7.5 mg/L. The analytical results presented in the Annual Environmental Monitoring Report for CY1986 do not indicate any significant adverse effects on adjacent water bodies from site operation.

5.1.2.4 Findings and Observations

5.1.2.4.1 Category I

None.

5.1.2.4.2 Category II

None.

5.1.2.4.3 Category III

1. Potential Oxygen Depletion of Nearby Surface Water From the Discharge of Aqueous Film Forming Foam (AFFF). AFFF is used throughout the SPR because it is effective in covering and thus extinguishing hydrocarbon liquid-based fires. The release of untreated AFFF into surface waters can have an adverse impact on surrounding wetlands. Although the material, available at the SPR sites will vary slightly in composition, they are characteristically classified by the manufacturers as biodegradable and practically nontoxic, having an LD₅₀ of greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered.) These materials also contain fluorocarbon surfactants (5 percent or less) that are not biodegradable. AFFF materials exhibit varying degrees of aquatic toxicity and have a high biochemical oxygen demand (BOD) and chemical oxygen demand (COD). Therefore, AFFF, if discharged to adjacent surface water, could result in temporary oxygen depletion in those waters in addition to being toxic to some aquatic species. Although there is no restriction on its use in emergency situations, state regulatory

agencies require that it be treated prior to discharge when used in training or performance tests. This creates a disposal problem. Under optimum conditions, sewage treatment plants of the types installed at the SPR sites can effectively treat waste AFFF material; however, 16,267 gallons of waste AFFF are expected to be generated annually during training exercises and performance tests at Sulphur Mines. The treatment plant could handle only an estimated 456 gallons per year. Subsequent to the on-site portion of the Survey, permission was received from the state to dispose of AFFF into SPR's saltwater disposal wells (Welsh, 1988). However, Sulphur Mines does not have containment facilities in place to capture and retain the entire volume of material that would be discharged in training and testing exercises. The use of AFFF for training and performance testing purposes has been temporarily curtailed until the waste disposal issue is adequately addressed.

2. Leaking Cavern Pad Could Release Contamination Into the Environment in the Event of a Spill of Brine or Oil. A leaking section of the (containment) dike on Cavern Pad 2 could result in either brine or oil contamination of the adjacent surface water in the event of a spill. Cavern pads are graded, diked areas constructed around wellheads that provide stable surfaces for equipment that is used when working on a well as well as containment for any spills or leaks that may occur. The site believes an existing leak, on the northeast side of the dike, is due to the pervious layer of shells on which the entire cavern pad is built. The leak is directly into the subsidence area from which water is pumped to the on-site ditch leading to Crystal Creek, which leads to Bayou d'Inde. The leaking section is to be repaired under Work Order 65708A900.

5.1.2.4.4 Category IV

1. Release of Spent Salt Solution to Adjacent Surface Waters Through an Unpermitted Discharge. Regeneration effluent from the potable water treatment unit is being discharged without a permit. The treatment unit installed on the potable water system includes a water softener that uses a salt solution for regeneration. The spent salt solution is discharged to a ditch that flows off-site. This point-source discharge is not included in the site NPDES discharge permit.
2. Potential Release of Oil From Leak in Meter Prover Pad Drain Valve. The storm-water drain valve on the meter prover pad is leaking and could result in the release of oil to the environment off-site in the event of a spill at the pad. The site is aware of this leak, and at the time of the on-site Survey, a work order had been issued to repair the valve.

5.1.3 Groundwater/Soil

5.1.3.1 Background Environmental Information

The caprock over the salt dome at Sulphur Mines attains a maximum thickness of 1,100 feet and is one of the thickest caprocks in the Gulf Coast region. Large deposits of high-quality native sulfur were discovered in this caprock during the drilling of early oil exploration wells. After several unsuccessful attempts to sink shafts and mine the sulfur conventionally, Herman Frasch invented a method to melt and recover the sulfur using pressurized hot water. Approximately 9,400,000 tons of sulfur were removed from the caprock using the Frasch process during active mining operations from 1902 to 1924.

The removal of this vast amount of sulfur from a relatively small dome caused the overlying caprock to collapse and created subsidence at the surface. Prior to mining, the dome had considerable topographic expression, up to 20 feet of relief from the surrounding terrain. However, present topographic relief is almost inverted from the pre-mining days, with a depression over the dome center. Subsidence continues to be a problem at the site. The ongoing rate of subsidence over the dome is approximately 1 inch per year (Whiting, 1981).

This subsidence made it necessary to bring in fill during active mining operations to shore up the foundations of the boiler houses and other support structures. Much of the fill was dredged from areas that exist today as ponds on the northern and western sides of the dome. The dumping of fill into subsiding areas has left almost no natural soil at the surface over the dome. The fill material is generally soft to firm clay with interlayered sand and silt pockets, hydraulically worked and deposited in layers by the action of the dredge outlet. The soils have been consolidated only by the weight of the deposits and by some surface drying. The fill is not homogeneous from the standpoint of engineering properties such as strength and moisture content.

The near-surface soil/groundwater environment is corrosive enough to cause deterioration of concrete pipe support structures. Acidic and sulfate salt solutions attack the chemical compounds present in Portland cement and thus lead to the deterioration of concrete. The sulfates present in the surficial soils are probably a result of the sulfur mining at the site. The acidic conditions may result from the reaction of perched groundwater with sulfates in the soil and the formation of a sulfuric acid solution in this soil/groundwater interaction (Whiting, 1981).

Groundwater in the caprock is high in chloride, sulfate, and calcium. Chloride concentrations can exceed 25,000 mg/L. Corrosion potential is increased by elevated temperatures (up to 225°F), which are probably due to residual thermal storage from mining operations. Water heated to 330°F was injected for sulfur mining, and the good insulating properties of rock cause this heat to be lost very slowly. Between the surface and the caprock, groundwater is fresh, with a chloride content less than 500 mg/L. The "200-foot" and "500-foot" sands of the Chicot Aquifer system are present over the caprock. Groundwater at the site was used for freshwater supplies during past mining operations. However, it is high in iron and manganese. Iron has been reported as high as 2.78 mg/L, an order of magnitude higher than the secondary drinking water standard of 0.3 mg/L. Similarly, manganese has been reported as 0.37 mg/L, compared to the secondary drinking water standard of 0.05 mg/L.

The fresh water of the Chicot Aquifer system is heavily pumped in the Lake Charles industrial area, about 12 miles southeast of the site. The Chicot Aquifer system is not heavily developed within 2 miles of the site. Only six active industrial supply wells are known to exist within this area. All six use the "500-foot" sand of the Chicot Aquifer system. Some domestic wells may be present within 2 miles of the site but are not recorded.

A noncommunity, public water supply well exists at Sulphur Mines, although the water is used only for sanitary purposes, fire water, and pump-seal flush water. No information is available on the depth or construction of this water supply well. Only bottled water is used for drinking purposes.

5.1.3.2 General Description of Pollution Sources/Controls

5.1.3.2.1 Brine Ponds

Two 100,000-barrel ponds can be used sequentially for brine during oil fill or for raw water during oil withdrawal. When used as brine holding ponds, they also function as oil/brine separators. Any oil present is skimmed off and transferred to the slop-oil system. The ponds have a polyethylene liner and an underdrain system to collect any leakage through the liner. These ponds are described further in Section 5.2.1.2.

The brine ponds have no monitoring wells, but the underdrain appears to function well as a leak detection system. It is checked weekly for liquid accumulation and analyzed monthly for salinity. Liner leaks are located and repaired when elevated salinity is consistently observed in water from the underdrain sump.

The water table is likely to be shallow at Sulphur Mines, although no piezometers are available for actual measurements. Groundwater may be entering the underdrain system and may be contributing to liquid accumulation and dilution of any pond leakage present. The potential for any pond leakage to escape the underdrain collection system is unknown. At the time of the on-site Survey, there was no evidence, from visible salt accumulation at the ground surface, of any such escape of leakage beyond the underdrain. Leakage of brine from the ponds into groundwater, if it actually occurs, would be a violation of Louisiana Statewide Order 29-B.

5.1.3.2.2 Mud Pits

Mud pits from the drilling of brine disposal wells were left in place at the wellpads and seeded. No attempt at stabilization was made. Brine disposal wells are drilled in locations away from the salt dome into saltwater-bearing sand layers beneath freshwater aquifers. Mud pits from the drilling of these wells contain rock cuttings and saltwater drilling muds. Mud pits from the drilling of cavern wells into the salt also contain salt cuttings.

Chrome lignosulfonate was added as a thinner to the drilling mud for the drilling of Brine Disposal Wells 3 and 4. Thinners in drilling muds act to minimize the development of gel structure in clays without altering the hydration of the clays. Radioactive tracer pellets were used to monitor the settling of the gravel pack at Brine Disposal Wells 2, 3, and 4. Some tracer pellets were flushed out of Well 4 during drilling. Most were recovered, but some could have remained in the Well 4 mud pit. The drilling history for Brine Disposal Well 4 (Williams-Fenix and Scisson, 1980) mentions the addition of these tracer pellets to the gravel pack, the presence of gravel in returns, and the finding of two "pills" in the shale pit (mud pit). However, it does not specify the radionuclide involved. Iodine-131 is the most probable radionuclide, since it is commonly used in disposal well investigations. For example, iodine-131 can be added to injected fluids and then tracked by gamma-ray logging to determine if the fluids have found a pathway anywhere outside the intended disposal zone. This method can be used to detect leakage through holes in the casing or vertical migration outside the casing. Iodine-131 has a short half-life of 8 days, which is suitable for short-term surveys and experiments. If it was indeed the radionuclide used during construction of Well 4 in 1979, it has long since decayed. Chrome and tracer pellet issues related to mud pits were addressed in the CERCLA Phase II Confirmation studies (see Section 5.2.5.2.2).

A second mud area, which resulted from the drilling of a reentry well at Cavern 7, was stabilized by compaction. No metal additives were used for this drilling. Salt cuttings would have been present in this mud area, and leaching of salt present in the mud could have occurred. However, this is no longer considered a problem because any leaching of the salt would have taken place years ago, and

at the time of the on-site Survey there was no physical evidence of any adverse impact. Muds for other cavern reentry wells were taken off-site for disposal.

5.1.3.2.3 Brine Disposal Wells

Sulphur Mines uses four injection wells for brine disposal. These wells are designated BDW-1, -2, -3, and -4. Acid treatment (acidizing) is used as frequently as necessary to remove precipitated salts from the sand formations and to reduce clay swelling. Careful attention to lines and valves during this process can prevent acid spills and, subsequently, potential shallow groundwater contamination. The wellpads are not diked to prevent acid and brine spills from entering surface water. Diked wellpads are used at Bayou Choctaw, which, like Sulphur Mines, is surrounded by freshwater wetlands.

The major groundwater concern from brine disposal operations is leakage of brine into freshwater aquifers overlying the brine disposal sands. Such cross-contamination between aquifers is prevented by periodic performance of a mechanical integrity pressure test. Disposal wells that fail this test are removed from service until repairs are performed and satisfactory performance is verified by re-testing.

Records for such testing were reviewed during the on-site Survey. The regulations are strictly enforced by the state. For example, test failures on BDW-3 and -4 caused compliance orders to be issued by the state. These orders set deadlines for corrective action or permanent plugging and abandonment. All requirements were met by the SPR for these particular well problems.

5.1.3.2.4 Abandoned Holes and Wells

Previous oil and gas exploration and sulfur mining activities created approximately 900 borings into the caprock. Most of these early wells were not sealed or plugged. They still act as vertical conduits for potential migration of groundwater between the caprock, overlying aquifers, and the surface. However, where casings have been pulled and the holes allowed to collapse, it is no longer possible to identify or to properly plug such penetrations. Potential degradation of groundwater over the dome itself from this source cannot be evaluated because of the absence of baseline data prior to drilling.

No abandoned, unplugged wells and holes have been identified at Sulphur Mines, according to SPR personnel.

5.1.3.3 Environmental Monitoring Program

No groundwater monitoring wells exist at Sulphur Mines, and none are required under existing environmental regulations. The two brine ponds that are adjacent to each other are the most likely source of groundwater contamination, but they are equipped with an underdrain system that functions both as a leak detector and leachate collector. Because of this underdrain, no monitoring wells appear to be needed as an additional leak detection system.

At another SPR site, Big Hill, monitoring wells are used as a backup leak detection system even though underdrains are present. However, Big Hill is an active and expanding site with large volumes of brine produced from leaching operations. In contrast, Sulphur Mines is now in operational standby, and relatively low volumes of brine are being handled. Thus, the need for a backup system is reduced.

Tears in the pond liner at Sulphur Mines and elevated salinity levels in the underdrain sump have occurred repeatedly. Nevertheless, this known leakage is contained in the underdrain system, and no known release to groundwater has occurred.

No chemical data on soils at Sulphur Mines have been collected by the SPR, and no environmental monitoring program for soils exists.

5.1.3.4 Findings and Observations

5.1.3.4.1 Category I

None.

5.1.3.4.2 Category II

None.

5.1.3.4.3 Category III

None.

5.1.3.4.4 Category IV

None.

PRELIMINARY

5.2 Non-Media-Specific Survey Findings and Observations

This section discusses findings and observations pertaining to waste management, toxic and chemical materials, radiation, quality assurance, and inactive waste sites and releases. These discussions do not include a background environmental information section, because the areas addressed are not necessarily tied to one medium, as was the case with the discussions in Section 5.1. These discussions include an environmental monitoring program section, where appropriate and where information was available.

5.2.1 Waste Management

5.2.1.1 Background Information

Operations at the Sulphur Mines site generate nonhazardous oilfield wastes, nonindustrial solid wastes, and small quantities of hazardous wastes. The site does not generate any industrial solid wastes, radioactive wastes, or radioactive/hazardous mixed wastes. Brief descriptions of all these wastes are as follows:

- Nonhazardous oilfield wastes are wastes generated by the drilling and production of oil and gas wells and which are not regulated by the provisions of the Louisiana Hazardous Waste Rules (LHWR) (Louisiana Statewide Order No. 29-B). Oilfield wastes include drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy [LHWR 1.3(d)(14)].
- Industrial solid wastes are wastes produced in the course of and resulting from any industrial, manufacturing, or mining process, and which are not subject to regulation under the Louisiana Hazardous Waste Management Plan. Trash, construction debris, and other non-process wastes are not considered industrial solid wastes (Louisiana Solid Waste Regulations, Chapter 3.0).
- Nonindustrial solid wastes include any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from commercial and agriculture operations, and from community activities; but do not include or mean solid or dissolved material in domestic sewage or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under Louisiana Revised Statutes (L.A.R.S.) 30:1094, or source, special nuclear, or

by-product material as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended, or hazardous waste subject to permits under LA R.S. 30:1131 et seq. (Louisiana Solid Waste Regulations, Chapter 3.0).

- Hazardous wastes include any wastes or combination of wastes, which because of their quantity, concentration, physical, chemical, or infectious characteristics, may (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Such definition shall be applied only to those wastes identified and designated as such by the Department of Environmental Quality, consistent with applicable Federal laws and regulations (Louisiana Hazardous Waste Control Law, LA R.S. 30:1133).
- Radioactive wastes are wastes containing radioactivity (i.e., materials that emit radiation, such as alpha and beta particles, neutrons, electrons and gamma rays).
- Mixed (radioactive and hazardous) wastes are co-contaminated with radioactive and hazardous waste materials.

Nonhazardous oilfield wastes are regulated by the Louisiana Department of Natural Resources Office of Conservation (LOC). Generators are responsible for the proper handling and transportation of these wastes to an approved commercial facility [Louisiana Statewide Order No. 29-B, Subparagraph 13.2(A)]. All shipments of oilfield wastes for off-site disposal must be accompanied by a properly completed LOC manifest, entitled Oil Field Waste Shipping Control Ticket, that is initiated by the generator (Louisiana Statewide Order No. 29-B, Subparagraph 13.6). Generators must use haulers that are registered with the Louisiana Public Service Commission to transport oilfield wastes. Because some oilfield wastes generated at Sulphur Mines are disposed of into underground injection wells, the following regulatory requirements must also be met (Allison, 1983).

- Preparation of annual injection well monitoring reports.
- Demonstration of the annular integrity of the disposal wells every 5 years.
- LOC site inspections twice a year.
- Notification to LOC regarding any pertinent changes or losses, including new well completions, well start-ups, well conversions, and well abandonments or losses that can affect the freshwater aquifers.

In addition, ponds used to hold oilfield wastes, such as the Sulphur Mines brine ponds, must be registered, operated, and closed in compliance with Subparagraphs 2.3 through 2.7 of Louisiana Statewide Order No. 29-B.

Oilfield wastes are temporarily exempted from regulation as hazardous wastes under Section 3001(b)(2)(A) of the 1980 Amendments to RCRA, pending further study by EPA. After submission of study results to Congress, and public hearings and opportunity to comment, the Administrator of EPA must determine either to promulgate regulations under the hazardous waste management provisions of RCRA (Subtitle C) or to declare that such regulations are unwarranted. Because wastes generated from activities associated with underground storage of hydrocarbons are considered oilfield wastes, the temporary exemption applies to the Sulphur Mines oilfield wastes. Exempted wastes are defined in detail in the Report to Congress, Management of Wastes from the Exploration, Development, and Production of Crude Oil, Natural Gas, and Geothermal Energy (EPA, 1987a), as well as in the Louisiana Hazardous Waste Rules and Regulations [LHWR 1.3 (d)(14)].

Nonindustrial solid wastes are regulated by the Louisiana Department of Environmental Quality (LDEQ), Solid Waste Management Division. Generators of these wastes are not required to hold generator permits or use manifests for off-site shipments (Louisiana Solid Waste Regulations). Because none of these wastes are disposed of at Sulphur Mines, no LDEQ disposal permit is required.

Hazardous wastes are regulated by the LDEQ Hazardous Waste Management Division. LDEQ was granted authority from EPA in January 1985 to manage the RCRA program in Louisiana. Because Sulphur Mines is a small quantity generator, it is subject to Chapter 21 of the Louisiana Hazardous Waste Rules (LHWR). However, LDEQ does not automatically exempt small-quantity generators from the full requirements of the LHWR. Instead, small-quantity generators are required to notify LDEQ in writing that they have claimed small-quantity generator status (LHWR 21.3). Before Louisiana was granted RCRA authority, EPA issued the site generator number LA8890032586 in response to SPR's 1980 Part A RCRA Section 3005 notification, but then reclassified the site to nonhandler status in June 1982 because it was a small-quantity generator (Paul, 1982).

5.2.1.2 General Description of Pollution Sources/Controls

5.2.1.2.1 Nonhazardous Oilfield Wastes

Nonhazardous oilfield wastes generated at the Sulphur Mines SPR site include brine, sludge from the brine pond, oily bottoms from underground storage tanks (USTs) and sumps, fluids from well

workover and pipeline cleaning, hydrotest water and fire system test water, oil-and-brine spill cleanup wastes, and oily sorbent pads and rags. Because all the caverns have been leached, anhydrite is no longer being generated. Drilling muds and salt cuttings also are no longer being generated because all cavern and brine disposal wells have been drilled (past disposal of drilling muds and salt cuttings is discussed in Section 5.2.5.2.2). Brine and fluids from well workover and pipeline cleaning are disposed of into DOE-owned and -operated underground injection wells on-site. Hydrotest water and fire system test water are either disposed of into the DOE injection wells or discharged to surface water if salinity levels are below three parts per thousand. Pond sludge, bottoms from USTs and sumps, and cleanup wastes (i.e., oil- or brine-contaminated soils) are shipped to the Campbell Wells commercial disposal site in Mermentau, Louisiana, to be landfarmed. Oily sorbent pads and rags are temporarily stored in a dedicated dumpster at the laydown yard and taken to the BFI Woodland Hills landfill in Sulphur, Louisiana. This landfill is permitted for disposal of all nonhazardous wastes (i.e., oilfield, industrial, and nonindustrial solid wastes). According to site personnel, all oilfield wastes are transported by haulers registered with the Louisiana Public Service Commission to haul such wastes. Manifests for the last quarter of 1987, which were reviewed by the Survey team, indicate that 690 barrels (28,980 gallons) of brine pond sludge were shipped to the Campbell Wells site and that 34 cubic yards of oily sorbent pads and rags were shipped to the BFI landfill.

The two brine ponds at Sulphur Mines are used to hold freshwater prior to pumping it into the caverns during oil transfer operations and to collect brine prior to its disposal. SPR submitted the required production pit notifications for the two ponds to the LOC Inspection and Mining Division in July 1986 (Gray, 1986b). The ponds were installed in 1980, and each has a capacity to hold 100,000 barrels (4.2 million gallons). Each pond is 515 feet long, 150 feet wide, and 10 feet deep. The ponds were built on clay, and an underdrain system was installed to collect any leakage. This underdrain system is connected to a sump, and its content is analyzed routinely for salinity. There are no groundwater monitoring wells in the area used to detect pond leakage. Both ponds also have a synthetic Hypalon® liner; they do not have concrete liners. The synthetic liners have leaked in the past, based on high salinities detected in the sump, and have been patched twice (i.e., December 1986 and December 1987). Monitoring data that were reviewed by the Survey team indicate that leakage is controlled for a while after repairs (i.e., salinity levels in the sump decrease). Potential for groundwater contamination from pond leakage is discussed in Section 5.1.3.2.1.

There are four DOE owned and operated brine disposal wells located 1.5 miles southwest of the site. These wells discharge to a saltwater aquifer and are used when brine salinity levels are sufficient. Periodically the wells are acidized to keep the sand formations open (i.e., to remove precipitated

salts and to reduce clay swelling). Refer to Section 5.1.3.2.3 for further discussion of brine disposal wells.

5.2.1.2.2 Nonindustrial Solid Wastes

Nonindustrial solid wastes include trash, used oil, and solids from the package sewage treatment plant. Trash is disposed of in dumpsters and hauled off to the BFI landfill. Used oil (e.g., hydraulic and lubricating oils) is collected into vacuum trucks along with slop oil (i.e., recovered crude oil spilled or leaked during routine operations) and taken to the West Hackberry SPR to be injected into oil-filled caverns. Solids from the sewage treatment plant are taken to a wastewater treatment facility in Lake Charles, Louisiana.

5.2.1.2.3 Hazardous Wastes

Sulphur Mines generates small quantities of hazardous wastes, including paint wastes and solvents, on a routine basis. Most of the hazardous substances used on-site are consumed, and thus, to the Survey team, less than 100 kilograms per month of hazardous wastes appeared to be generated. According to site personnel, some paint wastes are disposed of onto sorbent pads, a practice which allows volatile organic compounds to evaporate and remaining constituents to harden. The resultant wastes are nonhazardous. After the sorbent pads and wastes have dried, they are placed into trash dumpsters and shipped to the BFI landfill as nonindustrial solid waste. The solvent used on-site for degreasing and cleaning is Varsol, which is a flammable petroleum distillate and maybe a RCRA-characteristic waste if, when spent, the flash point is above 140°F (EPA Hazardous Waste Number D001). Spent Varsol is not a RCRA-exempt nonhazardous oilfield waste, because it is not derived from crude-oil production or storage [LHWR 1.3 (d)(14)]. It is collected in vacuum trucks, along with slop oil and used oil, and taken to the West Hackberry SPR (refer to Section 5.2.1.2.2).

Sulphur Mines did not manage its hazardous wastes in compliance with Chapter 21 of the LHWR. At the time of the on-site Survey, the site had not notified LDEQ that they had claimed small-quantity generator status in accordance with LHWR 21.3. The site also was not authorized to render paint wastes nonhazardous or to mix spent Varsol with slop oil and used oils, as required by LHWR 21.8(c). The Survey team did not see any accumulation of paint wastes or spent Varsol on-site. Therefore, it is not known how the site accumulates and stores these wastes, and if applicable regulations are followed. For example, accumulation drums should be clearly marked with the words, "Hazardous Waste" [LHWR 21.8(d)(2)] and drum labels should indicate the date on which waste accumulation began [LHWR 21.8(d)(1)]. No such marked or labeled drums were observed by the Survey team. In

addition, a waste storage area should consist of an impervious base with sufficient containment to retain a spill [LHWR 21.8(d)(3) and 12.6]. However, no such storage area was identified.

5.2.1.2.4 Underground Storage Tanks

There are two underground storage tanks (USTs) at the Sulphur Mines SPR facility. One is located at the main site to collect slop oil from the pig launcher/receiver area and the meter skid pad, and the other is located on the other side of the intracoastal waterway at the oil pipeline valve station No. 2 to collect oil from the pressure relief valve. Neither tank has been used to store wastes. The tank at the main site is made of fiberglass-reinforced plastic and has a 2,730-gallon capacity. The tank (200-gallon capacity) at the valve station is made of steel and has no cathodic protection. At the time of the Survey, the tanks were less than eight years old. While SPR does not have a leak detection program for USTs, the potential for UST leakage at Sulphur Mines appears to be low and does not present a significant environmental risk at this time. The two USTs were reported to the State in accord with RCRA Subtitle I requirements (Teerling, 1986d).

Oil collected from the USTs is taken via vacuum truck to the West Hackberry SPR site to be injected into the cavern system. Manifests for the last quarter of 1987 indicate that 185 barrels (7,770 gallons) of slop oil were trucked to West Hackberry.

The UST at the main site also collects storm water that drains from the pig launcher/receiver area and the meter skid pad. This water is collected in a vacuum truck, shipped to the West Hackberry SPR, and placed in West Hackberry's slop-oil tank.

5.2.1.3 Findings and Observations

5.2.1.3.1 Category I

None.

5.2.1.3.2 Category II

None.

5.2.1.3.3 Category III

None.

5.2.1.3.4 Category IV

1. Noncompliance with Louisiana Hazardous Waste Regulations for Small-Quantity Generators. Sulphur Mines generates small quantities of two hazardous wastes (i.e., paint wastes and spent Varsol, a flammable solvent) on a routine basis. These wastes are not managed in compliance with Chapter 21 of the Louisiana Hazardous Waste Rules (LHWR).

According to site personnel, paint wastes and Varsol are generated on a routine basis but in small quantities (i.e., the total quantity of both wastes is less than 100 kilograms per month). Paint wastes are disposed of onto sorbent pads, which allows volatile organic compounds to evaporate and remaining constituents to harden. The resultant wastes are nonhazardous. After the sorbent pads and wastes have dried, they are placed in plastic bags, which are placed into trash dumpsters and shipped to the BFI landfill as nonindustrial solid waste. Varsol, which is a flammable solvent and may be a non-oilfield, RCRA-characteristic waste when spent (EPA Hazardous Waste Number D001), if its flash point is below 140°F, is collected in vacuum trucks, along with slop oil (i.e., recovered crude oil spilled or leaked during routine operations) and used oil (i.e., hydraulic and lubricating oils), and taken to the West Hackberry SPR to be injected into the crude-oil storage caverns.

Because these wastes are generated in small quantities, their management must comply with Chapter 21 of the LHWR. Chapter 21 requires that the generator notify the State that they have claimed small-quantity-generator status, accumulate hazardous waste in properly marked containers on impervious surfaces, and properly dispose of hazardous waste materials. The site is not exempt from all LHWR, because the wastes are routinely generated [see LHWR 1.3(d)(1)] and are not oilfield wastes [see LHWR 1.3(d)(14)]. However, Sulphur Mines was not in compliance with the LHWR. At the time of the on-site Survey, the site had not notified LDEQ that it had claimed small-quantity generator status per LHWR 21.3. The site also was not authorized to render paint wastes nonhazardous or to mix spent Varsol with slop oil and used oils, as required by LHWR 21.8(c). The Survey team did not see any accumulation of paint wastes or spent Varsol on-site. Therefore, it is not known how the site accumulates and stores these wastes or whether applicable regulations are followed. For example, accumulation drums should be clearly marked with the words, "Hazardous Waste" [LHWR 21.8(d)(2)], and drum labels should indicate the date on which waste accumulation began [LHWR 21.8(d)(1)]. No such marked or labeled drums were observed by the Survey team. Furthermore, a waste storage area should consist of an impervious base with sufficient

containment to retain a spill [LHW/R 21.8(d)(3) and 12.6]. However, no such storage area was identified at the time of the on-site Environmental Survey.

5.2.2 Toxic and Chemical Materials

5.2.2.1 General Description of Pollution Sources/Control

5.2.2.1.1 Toxics Management

The control of toxic and chemical materials at Sulphur Mines is the combined responsibility of the Purchasing (based at West Hackberry), Quality, Safety, and Environmental Departments. The Purchasing Department is responsible for circulating purchase requisitions to representatives of the Safety and Environmental Departments at Sulphur Mines. The Quality Department requests that the supplier provide a current Material Safety Data Sheet (MSDS) for all products used at Sulphur Mines. The Environmental Department can reject the purchase or use of a particular product at Sulphur Mines due to potential occupational health or environmental concerns. An inventory of toxic and chemical materials at the site had been compiled at the time of the Environmental Survey.

The primary location for the storage of toxic and chemical materials at Sulphur Mines is the Laydown Yard (Figure 5-6). The Laydown Yard at Sulphur Mines is out-of-doors, and 55-gallon drums and other containers of toxic and chemical materials are stored on drum racks or wooden pallets placed on the ground. At the time of the on-site Environmental Survey, the following inventory of toxic and chemical materials was stored in the Sulphur Mines Laydown Yard: ten 55-gallon drums of biocide (pipeline corrosion inhibitor); 3 drums of cleaners; 2 drums of flammable solvents; 20 drums of AFFF; and 6 flammable materials storage cabinets. This area is not protected from adverse weather conditions (i.e., lacks a roof and walls), and impervious flooring and curbing to contain potential spills has not been provided. The Sulphur Mines Laydown Yard is also located in an area of the site where rainwaters collect and pool during and after heavy rainfalls. Therefore, in the event of a drum leak or rupture, spilled substances would contaminate surrounding soils and could be released into nearby surface waters. The storage of toxic and chemical materials at locations lacking effective spill control measures has previously been identified during environmental audits conducted by the operating contractor at other SPR sites (Teerling, 1987c), an EPA inspection of the Weeks Island Site (Townsend, 1986), and a DOE-PMO Site Management Appraisal at the St. James Marine Terminal (Wagoner, 1987). Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous waste) drum storage areas, such measures are considered good management/operational practice. A request to install covered drum storage racks

Source: Adapted by DOE Environmental Survey Team from BPS, 1897h.

FIGURE 5-6

LOCATION OF LAYDOWN YARD AT SULPHUR MINES
STRATEGIC PETROLEUM RESERVE

at all SPR sites was submitted to DOE by BPS but was not authorized (Teerling, 1987d). BPS is in the process of submitting similar requests to DOE to construct such facilities on a site-specific basis.

At present, Sulphur Mines relies upon the labels placed upon containers of toxic and chemical materials by the manufacturer to inform workers of the potential hazards associated with these materials, and regularly inspects these containers to determine if the manufacturers' labels are present. According to site personnel, Sulphur Mines has undertaken the development of a site-specific labeling system (Huff, 1987b). Although not required by current regulations, in general, site-specific labeling systems are increasingly being used on a voluntary basis to facilitate compliance with such regulations. In addition, BPS has established formal procedures to comply with the requirements of the OSHA Hazard Communication Standard and similar requirements imposed by Texas and Louisiana (BPS, 1987b).

5.2.2.1.2 Tank Farm Facilities

Underground Storage Tanks

Two USTs are present at Sulphur Mines (Teerling, 1986d). Neither tank has been used to store wastes. For a complete discussion of the USTs at Sulphur Mines, see Section 3.2.1.2.4.

Above-Ground Storage Tanks

There are five above-ground storage tanks at Sulphur Mines used to store toxic and chemical materials. These include

- Two approximately 1,000-gallon tanks used to store gasoline at the Sulphur Mines fuel station. An earthen dike has been constructed around these two tanks as a secondary containment measure in the event of a spill (i.e., overflow, tank rupture, etc.).
- A 500-gallon tank used to store diesel fuel that is located within the dike for the gasoline tanks at the fuel station.
- A 2,500-gallon diesel tank at the raw-water-intake structure that is surrounded by a concrete containment dike.
- A 168-gallon diesel tank for the emergency generator at the fire water pumps that is not diked.

5.2.2.1.3 Spill Prevention, Control, and Countermeasures (SPCC) Plan

The Sulphur Mines site handles large volumes of crude oil and is located close to navigable waters. As a result, the requirements of the EPA Oil Pollution Prevention regulations (40 CFR 112) are particularly applicable to the site. In response to these requirements, Sulphur Mines has prepared and implemented an SPCC Plan (BPS, 1986d) and a Spill Contingency Plan (BPS, 1986e). These documents contain listings of potential spill sources; type and quantity of material that could be released; personnel and equipment resources; and spill evaluation, support, and response procedures. Containment dikes that drain to sumps with oil/water separators have been constructed at each cavern wellpad. A sump has also been provided at the pig trap, and an oil/water separator is present at the high-pressure pump pad. The meter prover station rests on a diked concrete pad.

An Emergency Response Team (ERT) has been organized at Sulphur Mines. ERT members receive 40 hours of training at the ERT Academy at Lamar University (Huff, 1988a). Some members have also attended an additional 40-hour course on oil spill control and cleanup at Texas A&M University, Galveston, Texas. An inventory of spill control equipment is maintained at the site.

Formal monthly inspections of the site for deficiencies related to spill prevention and control are performed by the Capline Environmental Specialist (BPS, 1986d). The inspection report is forwarded to the Sulphur Mines Site Manager for review and approval. During CY 1986 no reportable oil or brine spills occurred at Sulphur Mines (Teerling, 1987e). SPR has established formal reporting requirements for oil spills of one or more barrels, or oil spills of any quantity on navigable waterways. Similar reports must be prepared for brine spills of any quantity leaving the site or five or more barrels on-site. For spills of hazardous substances, the reporting requirements established by EPA have been implemented.

5.2.2.1.4 Polychlorinated Biphenyls (PCBs)

It is the policy of SPR not to permit on any SPR site any equipment that is known to contain fluids with a PCB concentration in excess of 5 parts per million (ppm) (BPS, 1987e). One oil-filled transformer is located at Sulphur Mines. When the oil in this transformer was tested in 1984, no PCBs were detected (Huff, 1988b). No PCB-containing pole mounted transformers, capacitors, or circuit breakers are known to be present at the site.

5.2.2.1.5 Pesticides

Pesticides (i.e., insecticides, herbicides, and rodenticides) are used at Sulphur Mines and are applied both by site and contractor personnel. Restricted-use pesticides (i.e., pesticides that according to EPA must be applied only by a certified pesticide applicator or persons directly supervised by a certified pesticide applicator) are used only by contractor personnel who are licensed to handle such materials (Teerling, 1987f). The pesticides currently applied by contractor personnel include Demon 40 WP and Dursban (insecticides), and Talon-G (rodenticide).

Sulphur Mines personnel apply Amdro pesticide for fire ants and Roundup, Velpar L, and Rodeo herbicides for weed control. Calcasieu Parish performs all insecticide spraying for mosquito control. Written procedures governing the use of pesticides at Sulphur Mines have not been established. Application records are not maintained. Site personnel indicated that pesticides are applied in accordance with the directions on the pesticide container labels.

The approximate 1-year supply of the pesticides used at Sulphur Mines is stored in a locked building in the Laydown Yard. This location was inspected during the Environmental Survey and was found to be in an orderly condition, with no evidence of leaks or spills. In addition to the herbicides that are applied by Sulphur Mines personnel at the site, a crew stationed in Sulphur Mines is responsible for spraying herbicides at road crossings and valve stations on both the crude oil pipelines for Sulphur Mines and West Hackberry, and the brine discharge and raw water lines for West Hackberry. Herbicide 2,4-D is used for this purpose. Application records are not maintained. Any mixing of pesticides required prior to application is conducted east of the Control Building adjacent to the Maintenance Shop.

A commercial aerial spraying contractor is also used to spray herbicides (Tordon K and Esteran 99) along the entire length of these pipelines. This contractor meets all the requirements for aerial herbicide spraying mandated by the Louisiana Department of Agriculture (Calhoun, 1986).

5.2.2.1.6 Asbestos

SPR operations began in the late 1970s. As a result, the various SPR sites, including Sulphur Mines, were constructed using relatively little asbestos-containing materials. However, asbestos-containing gaskets are in place on the SPR pipelines. SPR has established procedures for removing and disposing of these asbestos-containing gaskets during routine maintenance (BPS, 1986c). These procedures will be utilized at Sulphur Mines until all asbestos-containing gaskets have been properly removed, disposed, and replaced with asbestos-free gaskets.

5.2.2.1.7 Chlorofluoroalkanes

Approximately 70 pounds of chlorofluoroalkanes are used at Sulphur Mines annually (Teerling, 1987h). These materials are used primarily as refrigerants in air conditioning units or to clean electrical parts. As a group, the chlorofluoroalkanes are relatively volatile compounds, and potential environmental problems due to vapor emissions can result if they are not properly handled and stored. All of the chlorofluoroalkanes purchased by Sulphur Mines in 1987 were CFC-12 and CFC-13; these materials are gases at room temperature. CFC cylinders are stored indoors at the Sulphur Mines Maintenance Shop until needed. During the Environmental Survey, chlorofluoroalkanes appeared to be stored properly at Sulphur Mines.

5.2.2.2 Findings and Observations

5.2.2.2.1 Category I

None.

5.2.2.2.2 Category II

None.

5.2.2.2.3 Category III

1. Inadequate Secondary Containment Measures. There is a potential for releases of oil and chemical materials into the environment from drum storage areas lacking effective spill containment. Drums containing chemical products are currently stored out-of-doors, unprotected from adverse weather conditions at locations lacking impervious flooring and curbing to contain spills. In the event of a drum leak or rupture, spilled substances would contaminate surrounding soils and could possibly be released into nearby surface waters. This deficiency was previously identified during BPS environmental audits of other SPR sites, an EPA inspection of the Weeks Island, another SPR site, and a DOE Site Management Appraisal at the St. James Marine Terminal. Although neither state nor Federal regulations currently require spill containment for certain (nonhazardous waste) drum storage areas, such measures are considered good management/operational practice.

Deficient storage of chemical products noted by the Environmental Survey team at Sulphur Mines include

- Drums of flammable solvents and other materials and six flammable storage cabinets located out-of-doors in an area of the Sulphur Mines site where rainwaters collect and pool during and after heavy rainfalls. The inventory of materials stored at the time of the Environmental Survey consisted of ten 55-gallon drums of pipeline corrosion inhibitor biocide; 3 drums of cleaners, 2 drums of flammable solvents, and 20 drums of AFFF.
- The 168-gallon diesel tank for the emergency generator at the fire water pumps is not diked.

5.2.2.2.4 Category IV

None.

PRELIMINARY

5.2.3 Radiation

5.2.3.1 Background Information

Radioactive materials are used at the SPR sites only in the form of sealed sources. Sealed sources are not likely to present an environmental risk unless they are improperly used or develop undetected leaks. The use of radioactive materials in Louisiana is regulated by the State of Louisiana Department of Natural Resources, Office of Conservation, Nuclear Energy Division.

The Louisiana Radiation Regulations permit, without the need for a specific license, the possession and use of radioactive materials in devices designed and manufactured for the purpose of detecting, measuring, gauging, or controlling thickness, density, level, interface, location, radiation, leakage, or qualitative or quantitative chemical composition, or for producing light or an ionized atmosphere. The radioactive materials used at the SPR sites are in this category. These regulations require that sealed sources be affixed with labels containing appropriate warnings and precautions and that they be tested for leakage at no longer than 6-month intervals, or at such other intervals as are specified by the manufacturer. Devices containing only tritium or not more than 100 microcuries of other beta- and/or gamma-emitting material or 10 microcuries of alpha-emitting materials and devices held in storage in the original shipping container prior to initial installation need not be tested for any purpose. The regulations further state that records of tests for leakage of radioactive material be maintained until the source is transferred or disposed (LR, 1976).

Radiography and well logging operations are provided to the SPR by contractors. The contractors hold the licenses for the possession and use of sources needed for these activities and are responsible for applicable radiological safety. Louisiana Radiation Regulations require that, in the event a well-logging source cannot be retrieved, a permanent identification plaque must be mounted at the surface of the well. The plaque must contain (1) the word "caution," (2) a radiation symbol, (3) the date the source was abandoned, (4) the name of the well operator and owner, (5) the well name and well identification number, (6) an identification of the sealed sources by radionuclide and quantity of activity, (7) the depth of the source, and (8) an appropriate warning.

5.2.3.2 General Description of Pollution Sources/Controls

There are seven gamma-ray densitometers at the Sulphur Mines site. Six of these units contain 200 mCi of cesium-137, and the other contains 4,000 mCi of cesium-137. The sources are required to be leak tested once every 3 years. The most recent leak test was conducted in May 1987. No leaks

were detected. The Survey team examined the mounting of selected units on brine lines and found them to be secure.

A gamma-ray well-logging source was determined to be irretrievable at Cavern 5 on February 10, 1987. The source contained 125 mCi of cobalt-60. A metal plaque containing the information required by the Louisiana Radiation Regulations is mounted at the surface of the well.

5.2.3.3 Findings and Observations

5.2.3.3.1 Category I

None.

5.2.3.3.2 Category II

None.

5.2.3.3.3 Category III

None.

5.2.3.3.4 Category IV

None.

5.2.4 Quality Assurance

5.2.4.1 General Description of Data Handling Procedures

The quality assurance aspects of the environmental monitoring program at the Sulphur Mines site are governed by the BPS Environmental Programs and Procedures Manual (Teerling, 1986c). The requirements of the procedures are summarized in Section 3.2.4.1. The environmental monitoring program at the Sulphur Mines site consists of discharge monitoring of storm-water runoff and the sewage treatment plant effluent as required by the NPDES permit. Sulphur Mines also conducts surface-water monitoring to assess the impact of site operations on surrounding surface-water bodies. The surface-water monitoring is not required by any regulatory agencies. The water monitoring at Sulphur Mines is discussed in more detail in Section 5.1.2.3.

There is no laboratory located at the Sulphur Mines site and no analyses other than pH determinations are conducted on-site. The Sulphur Mine analyses are conducted at the West Hackberry laboratory. The discussion in Section 6.2.4.2 is applicable to the quality assurance practices associated with Sulphur Mines analyses.

Samples at Sulphur Mines are collected by the Site Environmentalist and Field Chemist with responsibilities for both Sulphur Mines and West Hackberry, and by operations personnel. Operations personnel have received training in sample collection and pH determination. This training has been documented by site personnel. A written sampling procedure was developed by the Environmental Control Department (ECD) for operations personnel, but it is considered to be an operations procedure rather than an ECD procedure. There is no ECD procedure to govern the sample collection by either the Field Chemist or Site Environmentalist. No samples were collected at Sulphur Mines while the Survey team was on-site.

5.2.4.2 Findings and Observations

5.2.4.2.1 Category I

None.

5.2.4.2.2 Category II

None.

5.2.4.2.3 Category III

None.

5.2.4.2.4 Category IV

1. Lack of Written Sampling Procedures. At the time of the on-site Survey, Sulphur Mines did not have complete written procedures for the field collection, by ECD personnel, of water samples for NPDES monitoring. A written sampling procedure has been developed for operations personnel, but it is not considered to be an ECD procedure and is not used by ECD personnel for sampling. No sampling was conducted at Sulphur Mines while the Survey was on-site; however, the ECD personnel who collect samples at Sulphur Mines are also responsible for sampling at the West Hackberry site, where the Survey team did observe sampling. At West Hackberry, no deficiencies were observed that would be expected to compromise the validity of the data. Written procedures would provide documentation that proper sampling methodologies are being used in a consistent manner by all samplers and would help support the validity of the data. In addition, the use of written procedures for training of new or substitute samplers would help ensure that there would be no change in sampling methodology with a change in personnel.

5.2.5 Inactive Waste Sites and Releases

5.2.5.1 Background Information

The Survey team investigated each of the SPR facilities to identify inactive waste sites and releases of hazardous materials that are sources or potential sources of environmental contamination. Inactive sites and hazardous materials releases reviewed by the Environmental Survey team may either be subject to various environmental regulations or may not be addressed by the environmental regulatory framework. The Survey team identified and inventoried all inactive sites and hazardous materials releases that may cause environmental problems, regardless of the regulatory status of the sites or materials involved. Document reviews, personal interviews, and brief site visits are the basis for the observations and findings described in this section.

Many of the inactive waste sites and releases identified by the Survey team may be subject, via the Federal facilities provision, to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and associated Executive Orders. Therefore, DOE Order 5480.14 (under revision) was issued on April 26, 1985, to implement DOE's CERCLA Program, which is intended to define actions to identify and evaluate inactive hazardous waste sites on DOE installations and to effect remedial actions where warranted. The first two phases of a five-phased program, prescribed under DOE Order 5480.14, were completed before the Survey team visited the SPR sites. A report was prepared under each of these two phases, the Phase I CERCLA Report: Installation Assessment, April 1986 (BPS, 1986b), and the Phase II CERCLA Report: Confirmation, April 1987 (BPS, 1987f). According to DOE 5480.14, Phase I was intended to "evaluate site history and records, and to locate and identify those inactive hazardous waste disposal sites that may pose a risk to health, safety and the environment as a result of migration of hazardous substances." Phase II was described by DOE 5480.14 as an effort to "quantify, by preliminary and comprehensive environmental survey, the presence or absence of hazardous substances that may pose a risk to health, safety, and the environment." The Survey team used the Phase I and II CERCLA Reports to aid in identifying and evaluating inactive waste sites and releases.

Since passage of the Superfund Amendments and Reauthorization Act (SARA) of 1986, DOE has revised its CERCLA program and DOE Order 5480.14 to implement the new SARA requirements. DOE has replaced the five-phased program and adopted the Environmental Protection Agency (EPA) program as outlined in the National Contingency Plan. DOE also issued guidance to its facilities on how to use data collected under its old CERCLA program to meet requirements of SARA. Conversion of Phase I CERCLA Reports (i.e., Installation Assessments) to Preliminary Assessments (i.e., the first step under the EPA program) was to be completed by April 1988.

This section provides an overview of uncontrolled releases of hazardous substances into the environment from inactive waste sites and spills at Sulphur Mines. Relevant information was obtained from SPR personnel and files, employees of former site tenants, and the Phase I and Phase II CERCLA Reports.

5.2.5.2 General Description of Pollution Sources/Controls

Sulphur Mines has inactive waste sites associated with past waste disposal and areas where potentially hazardous substances have been released into the environment as a result of past activities. These include drilling mud disposal pits and residuals from past sulfur mining operations. Minor oil and brine spills have also occurred on-site. The CERCLA Phase I Report addresses historic sulfur mining and drilling mud disposal at Sulphur Mines. The CERCLA Phase II Report provides follow-up information on the drilling muds. Oil and brine spills at the site are described in Sulphur Mines environmental incident and monitoring reports.

5.2.5.2.1 Past Sulfur Mining

The Union Sulphur Company mined sulfur at Sulphur Mines from 1896 to 1924. Union Texas and Pittsburgh Plate Glass began solution mining salt in 1946 and also mined sulfur in the 1960s. Some of the solution-mined caverns, some of which are now in use by DOE for petroleum storage, were used for storage of liquefied petroleum gas and ethylene. The major environmental effects from this industrial history are subsidence and subsequent inundation of the low-lying areas with water, and acidification of the soil as a result of elemental sulfur having been spread over the land surface and driven into the soil by mining operations (BPS, 1986b). No evidence of hazardous waste disposal was identified through interviews with a retired Union Texas employee and examination of historical records at the Brimstone Museum, located in Sulphur, Louisiana, which was conducted during the Phase I CERCLA Installation Assessment. The Survey team reviewed site records and photographs, as well as information at the Brimstone Museum, to investigate and confirm the industrial history of the site. The site tour revealed no additional potential sources of environmental contamination from past activities; however, stressed vegetation from sulfur deposition and acid runoff was widely apparent.

5.2.5.2.2 Disposal of Drilling Muds

A chrome lignosulfonate was added to the muds used to drill the reentry wells into Caverns 2 and 6 and Brine Disposal Wells 3 and 4 (BPS, 1986b). Muds used for all of the reentry wells were disposed

of off-site at approved commercial facilities, with the exception of muds used at Cavern 7. Muds for this well were disposed of in trenches adjacent to the well, and were later moved across the road and stabilized by compaction. No metal or other hazardous mud additives were added to muds used to drill the Cavern 7 well.

Muds used to drill Brine Disposal Wells 3 and 4 were left in pits adjacent to the wells (see Figure 5-2). These pits were covered with soil and seeded. Approximately one-third of each of these pits was subsequently covered by the wellpads. Because chrome lignosulfonate was used in the drilling muds for these two wells, materials in the pits were analyzed under CERCLA Phase II (BPS, 1987f) for EP toxicity constituents. Chromium was not detected in either of the mud pits. Other EP toxicity substances (i.e., arsenic, barium, cadmium, lead, mercury, and silver) were detected but did not exceed EP toxicity regulatory levels.

Several radioactive tracer pellets from the brine pack used on Brine Disposal Well 4 are unaccounted for and may have remained in the mud pit (BPS, 1986b). No radiation levels above background were observed in scans of the areas. The probable radionuclide used in the pellets was Iodine-131. This radionuclide has a short half-life, and thus the pellets are, by now, harmless.

5.2.5.2.3 Oil and Brine Spills

The nature of SPR activities at Sulphur Mines creates the potential for crude oil and brine spills. A review of Sulphur Mines' environmental files shows numerous minor spills of this nature. None of the oil and brine spills at Sulphur Mines were of a regulatory reportable quantity, nor is there any indication of any permanent or major environmental damage. According to the site's Spill Prevention, Control, and Countermeasures Plan (BPS, 1986d), potential spill sources include the crude oil storage system, on-site oil handling, on-site brine handling, and off-site pipelines for oil and brine (refer to Section 5.2.2.1).

5.2.5.3 Findings and Observations

5.2.5.3.1 Category I

None.

5.2.5.3.2 Category II

None.

5.2.5.3.3 Category III

None.

5.2.5.3.4 Category IV

None.

PRELIMINARY

6.0 WEST HACKBERRY

The West Hackberry site is located in Cameron Parish, Louisiana, about 20 miles southwest of Lake Charles, Louisiana (Figure 6-1). The site is situated on 565 acres of land on top of the West Hackberry salt dome. The dome is covered by a distinct mounded overburden on its western portion, with elevations up to 21 feet (the highest point in Cameron Parish). The majority of the dome is approximately 5 feet above sea level.

Waterways near the site include Calcasieu Lake and the Calcasieu Ship Channel, about 3 miles to the east, as well as the Intracoastal Waterway, about 4 miles north of the site. Black Lake, a brackish water lake, borders the dome on the northern and western sides. Numerous canals and natural waterways, including Black Lake Bayou, connect Black Lake to Alkali Ditch and then reach northward to the Intracoastal Waterway. Black Lake Bayou, referred to locally as Kelso Bayou, continues wandering in an easterly direction from Black Lake, eventually connecting with the Calcasieu Ship Channel, northeast of the town of Hackberry.

Present land-use in Cameron Parish, where the West Hackberry site is located, reflects the fact that it is in a coastal marsh. About 70 percent of the parish consists of nondevelopable wetlands and water bodies. The salt dome and the area around it are used for the production of brine, oil, and gas. Agriculture in the area is limited to small segments of the elevated area over the salt dome, because the surrounding area is either marsh or lake. Cameron Parish includes the Sabine National Wildlife Refuge, the Lacassine Migratory Waterfowl Refuge, and the Rockefeller Wildlife Refuge and Game Preserve.

This storage site was acquired in 1977 and five existing brine caverns with a capacity of 49 million barrels were converted to oil storage. In addition, 17 new 10-million barrel caverns will increase the site's total capacity to 219 million barrels. By the end of 1986, 21 of the 22 caverns were completed and were 98 percent filled with crude oil; Cavern 117 was under construction, but contained no oil (Teerling, 1987b).

6.1 Media-Specific Survey Findings

The discussions in this section pertain to existing or potential environmental problems in the air, surface water, and groundwater/soil media. The discussions include a summary of the available background environmental information related to each medium, a description of the sources of pollution and their control techniques, a review of the environmental monitoring program specific

FIGURE 6-1

WEST HACKBERRY, LOUISIANA, SITE LOCATION
STRATEGIC PETROLEUM RESERVE

to each medium, and a categorization and explanation of the environmental problems found by the Survey team related to each medium.

6.1.1 Air

6.1.1.1 Background Environmental Information

The air portion of the Environmental Survey of the West Hackberry Site is designed to address existing and potential environmental impacts associated with releases of contaminants to the atmosphere. It includes a critical evaluation of air pollution sources and controls as well as compliance with air pollution regulations. Adherence to established environmental procedures is evaluated from the standpoint of environmental problems or risks. Principal regulations relating to air emissions used as guidance during the Survey include

- The Clean Air Act (CAA) and Amendments;
- Federal Regulations, including
 - National Ambient Air Quality Standards (NAAQS) (40 CFR 50)
 - Standards of Performance for New Stationary Sources (40 CFR 60)
 - National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61)
- Louisiana Air Quality Regulations.

The West Hackberry site is located in Cameron Parish, Louisiana, which is included in the Southern Louisiana-Southeast Texas Interstate Air Quality Control Region (AQCR) No. 106 (40 CFR 81.53, July 1, 1987).

The national ambient air quality standards (see Table 3-1) have been incorporated into Louisiana air pollution control regulations and are enforced throughout the state. The attainment status of the Cameron Parish portion of AQCR No. 106 is described (40 CFR 81.319, July 1, 1987) as follows:

Parameter	Status
Total Suspended Particulates	Better than National Standards
Sulfur Dioxide	Better than National Standards
Ozone	Cannot be Classified or Better than National Standards
Carbon Monoxide	Cannot be Classified or Better than National Standards
Nitrogen Dioxide	Cannot be Classified or Better than National Standards

The status of other criteria pollutants, including PM-10 particulate matter and lead, has not been published.

Wind data recorded at the Lake Charles Municipal Airport, which is about 20 miles northeast of West Hackberry, are representative of air-flow patterns at West Hackberry. Characteristic winds for stations near the SPR sites are discussed in Section 2.1.

6.1.1.2 General Description of Pollution Sources/Controls

Facilities at West Hackberry with potential for emissions of VOCs to the atmosphere (Figure 6-2) were addressed in a Certificate of Approval (Permit No. 1048) issued by the Louisiana Air Control Commission (LACC, 1978b). These facilities include a surge tank, a slop-oil tank, a brine/anhydrite pond, pump seals, and valve stems. The VOC emission rate limits for these sources were included in a data sheet attached as part of the Permit. These data are presented in Table 6-1. However, the Permit does not address construction and operating aspects of the development and filling of the 17 new 10-million barrel caverns. At the time of the Environmental Survey, no permit application had been filed.

6.1.1.2.1 Slop-Oil Tank

A 7,000-barrel (300,000-gallon) tank, which is a potential source of VOC emissions, is used to hold slop oils recovered from operation maintenance of pumps, strainers, etc.; various on-site crude-oil sumps; oil/water separators; and oil-contaminated water from the Sulphur Mines slop-oil tank, prior to injection of the oil into storage caverns. The tank was constructed, beginning in May 1977, with a fixed roof that was vented to the atmosphere to prevent pressure/vacuum buildup during fill/drawdown cycles. Although the tank is used to contain crude oil, the oil has lost most of its volatile content prior to transfer to the tank. The "weathered" crude has been demonstrated to have a true vapor pressure less than 0.75 pound per square inch absolute (psia), which is well below the 1.5 psia threshold that would cause the tank to be regulated under Standards of Performance for New Stationary Sources (40 CFR 60, Subpart K).

6.1.1.2.2 Surge Tank

A surge tank included in the Permit was a potential source of VOC emissions to the atmosphere. Prior to construction of a pipeline to the Sun Terminal in Nederland, Texas, crude oil for injection

FIGURE 6-2

LOCATION OF PERMITTED AIR-EMISSION SOURCES AT WEST HACKBERRY STRATEGIC PETROLEUM RESERVE

TABLE 6-1

**VOLATILE ORGANIC COMPOUND EMISSION SOURCES AND EMISSION RATE LIMITS
PER CERTIFICATE OF APPROVAL
WEST HACKBERRY SITE, STRATEGIC PETROLEUM RESERVE**

Source ID	VOC Emission Rate Limits, lb/hr			
	1978 Operations	1979 Operations	Withdrawal	Refill
Surge Tank	31.277	31.514	--	31.5
Slop-oil Tank	1.160	1.160	1.160	1.160
Brine Pond	--	--	--	11.828
Pump Seals	0.659	0.471	0.471	0.471
Valve Stems	0.396	0.284	0.284	0.284

Source: LACC, 1978b.

into the existing caverns was delivered by barges to an off-site 35,000-barrel surge tank that was owned by Amoco. The crude oil was then transported to on-site caverns by a temporary pipeline. Following completion of the pipeline to Sun Terminal, the Amoco surge tank was no longer used for SPR purposes and the temporary pipeline was removed.

6.1.1.2.3 Brine Pond

Brine and anhydrite settling ponds (combined capacity of about 330,000 bbl) installed to receive brine generated initially as a result of cavern construction. Later, it received brine that was displaced from the caverns as a result of crude-oil injection. The displaced brine occasionally carries entrained crude oil into the brine pond. In the brine pond, suspended solids (anhydrite) settle to the bottom, while suspended oil and dissolved organic compounds rise to the surface where they can be recovered. VOCs in the oil fraction can evaporate into the atmosphere.

6.1.1.2.4 Valve Stems and Pump Seals

VOC emissions are possible, if valve stems and pump seals leak. These potential sources are recognized in the Permit. VOC emission rate limits were calculated for various phases of operation (see Table 6-1).

6.1.1.2.5 Plant Road Dust

Although the Permit does not require control of unpaved road dust, West Hackberry uses applications of calcium chloride at 90-day intervals in an effort to minimize dust emissions. No estimate of length of road surface thus treated was available.

6.1.1.2.6 Space Heating

Space heating at West Hackberry is provided by electricity.

6.1.1.3 Environmental Monitoring

6.1.1.3.1 Monitoring of Ambient Air Quality

A monitoring program was initiated by a subcontractor at West Hackberry on October 1, 1982 to determine baseline ambient-air quality. The program continued through September 30, 1983 (York, 1984). Parameters monitored during that period were total suspended particulates, ozone,

and nonmethane hydrocarbons (i.e., volatile organic compounds). The total suspended particulate concentrations met both primary and secondary annual and 24-hour standards, while ozone exceeded the hourly standard (which is not uncommon in an AQCR designated as a nonattainment area for ozone). Although there are no current air-quality standards for nonmethane hydrocarbons, the maximum hourly value was 2.25 ppm (York, 1984). There are no regulatory requirements for continued air-quality monitoring.

6.1.1.3.2 Emission Monitoring

Periodic monitoring of sources of fugitive VOC emissions is not required in Louisiana. However, as required by the Louisiana Environmental Control Commission (Regulation 17.12), an Emissions Inventory Questionnaire (EIQ) was submitted to the Louisiana Air Control Commission (Broscoff, undated) prior to the conversion and fill of the existing caverns at the West Hackberry salt dome. The EIQ estimated VOC emissions for the following operations:

- 1977 Unloading Operation from Barge Dock
- 1978 Unloading Operation from Barge Dock
- Unloading Operations from Sun Terminal
- Slop-Oil Tank
- 150-Day Crude-Oil Withdrawal
- Subsequent Cavern Filling Operations

The VOC emissions projected in the EIQ are shown in Table 6-2. The Permit does not require any sampling or monitoring of these VOC sources.

The existing EIQ did not anticipate the expansion of the storage capacity of the West Hackberry site from the original 49 million barrels to the present capacity of 219 million barrels. The DOE-PMO indicated that submission of an updated EIQ was planned for the summer of 1988, when construction/fill are scheduled to be completed.

6.1.1.4 Findings and Observations

6.1.1.4.1 Category I

None.

TABLE 6-2

**PROJECTED EMISSIONS OF VOLATILE ORGANIC COMPOUNDS
WEST HACKBERRY SITE, STRATEGIC PETROLEUM RESERVE**

	Average lb/hr ⁽¹⁾	Maximum lb/hr	Annual tpy ⁽²⁾
1977 Unloading			
Surge tank	33.325	43.160	65.184
Pump seals	0.659	0.659	1.289
Valve stems	0.396	0.396	0.775
1978 Unloading			
Surge tank	24.158	31.277	52.471
Pump seals	0.659	0.659	1.432
Valve stems	0.396	0.396	0.861
Unloading from Sun Terminal			
Pump seals	0.471	0.471	(3)
Valve stems	0.284	0.284	(4)
Brine pond	31.514	31.514	11.345
Slop-Oil Tank	0.813	1.160	(5)
Crude-Oil Withdrawal			
Pump seals	0.471	0.471	0.848
Valve stems	0.284	0.284	0.511
Cavern Refilling			
Brine Pond	11.828	11.828	48.968
Pump seals	0.471	0.471	1.950
Valve stems	0.284	0.284	1.173

Source: (Brostoff, undated)

(1) lb/hr = pounds per hour

(2) tpy = tons per year

	<u>1977</u>	<u>1978</u>	<u>1979</u>
(3) Pump seals	--	1.040	0.345
(4) Valve stems	--	0.626	0.208
(5) Slop-Oil Tank	1.765	3.549	0.780

6.1.1.4.2 Category II

None.

6.1.1.4.3 Category III

None.

6.1.1.4.4 Category IV

None.

PRELIMINARY

6.1.2 Surface Water

6.1.2.1 Background Environmental Information

6.1.2.1.1 Surface-Water Bodies in Area

The West Hackberry Site is bounded on the north by Black Lake. This brackish body of water is connected to the Intracoastal Waterway (ICW), 4 miles north of the site, by Alkali Ditch. Other major bodies of water in the area (Figure 6-3) are Calcasieu Lake, formed by the Calcasieu River (east of the site) and the Gulf of Mexico, 16 miles south of the site.

6.1.2.1.2 Sources of Water Used at the Site

Raw water is pumped from an intake structure on the ICW for use in leaching, and oil drawdown operations. Water for the fire protection system comes from the ICW and Black Lake. Pumps are located at the fire water intake near the boat slip on the edge of Black Lake between Cavern Pads 6 and 7. Potable water for sinks, hose connections, and toilet flushing, is supplied by the Town of Hackberry. This city water supply is also used for bearing cooling water, and at the time of the on-site portion of the Survey, it was also being used for seal flushing and motor cooling water on the brine pumps. The seal flush and motor cooling waters are normally supplied by on-site well water. However, the well pump had not been operating for about 8 months at the time of the visit. Bottled water is supplied to the site for drinking (Chaterlain and Roberts, 1987).

6.1.2.1.3 Flood Plain

Floodwater levels in the area of West Hackberry are influenced by tidal fluctuations, hurricane and other storm surges, and torrential rains and runoff.

Elevations on-site range from about -2 feet in Black Lake to more than 20 feet in the central portion of the site. Hurricane Audrey, in 1957, resulted in a peak surge of 6.7 feet at the town of Hackberry, east of the site. The 100-year surge heights at the site have been estimated to be 4.5 feet and 6.5 feet by two separate studies (Whiting, 1980).

The maximum precipitation in a 24-hour period at the Lake Charles, Louisiana weather station (approximately 20 miles northwest of the site) was 16.88 inches in May 1980.

FIGURE 6-3

**SURFACE WATERS IN THE VICINITY OF WEST HACKBERRY
STRATEGIC PETROLEUM RESERVE**

6.1.2.2 General Description of Pollution Sources/Controls

6.1.2.2.1 Water Uses at Site

Although potable water is supplied to the site from the town of Hackberry's water distribution system, it is only used to supply water for brine pump seal flushing, bearing cooling, toilet flushing, hose connections, and sinks. Bottled water is used at the site for drinking. Other water uses at the site are supplied with raw water that is pumped from the intake structure on the ICW to the raw water holding pond. This pond is located within the same diked structure used for the brine/anhydrite ponds and serves as a surge tank for raw water use on-site. This includes water for leaching (e.g., preparing the oil storage caverns as described in Section 2.2.1) and the emergency supply for the fire protection system. The fire protection system is normally supplied with water from the pumps at the intake on Black Lake.

The bearing seals on the brine pumps must be continually flushed with fresh water to prevent erosion damage by materials in the brine. Because of the close tolerances involved in this application, well water (which is free of significant levels of particulate matter) is normally used for seal flushing. However, at the time of the on-site Survey, the well pump had been broken and out of service for the previous 8 months. City water was being fed to the system. The State of Louisiana requires that there be a 6-inch air gap where potable water systems are cross-connected to other non-potable systems. Such an air gap does not exist at West Hackberry. A related finding is presented in Section 6.1.2.4.4.

The fire protection system at West Hackberry, as is done at other SPR sites, uses Aqueous Film Forming Foam (AFFF) in order to improve the fire extinguishing capabilities of the system. This material is effective in covering and extinguishing hydrocarbon liquid-based fires. AFFF is obtained from a variety of suppliers through competitive bids; however, all the materials have similar characteristics of high biochemical and chemical oxygen demand (BOD and COD); are mostly biodegradable; contain 5 percent or less fluorocarbon surfactants, which are not biodegradable; and exhibit varying degrees of aquatic toxicity. However, they are classified as practically nontoxic in the manufacturer's literature because the oral LD₅₀ for rats is greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered.) The oxygen depletion due to the high BOD and COD coupled with the aquatic toxicity could result in short-term environmental degradation, if this material is released to adjacent surface water. The as-purchased concentrate is mixed with the fire protection water to provide a 3 percent solution to be sprayed on the fire. The foam deluge system on the pump pads have automatic foam proportion systems to provide the required mixture. The fire monitors (water

cannons) at the cavern pads use eductors to siphon the concentration directly from drums placed adjacent to the monitor. The mobile fire fighting equipment is also capable of using AFFF. SPR has estimated that 18,967 gallons of 3 percent AFFF solution would be generated annually in training and testing exercises at West Hackberry. Because the AFFF is biodegradable, the sewage treatment plant could treat the waste; however, the annual capacity of the existing systems for treating AFFF is only 456 gallons. In addition to the dikes at the cavern wellpads and slop oil tank that contain the foam used in fire-fighting or training exercises at those locations, the high-pressure pump pad and the meter prover pad have containment (North Deluge Pond and East Deluge Pond). These ponds would collect the runoff if the foam deluge system was activated. SPR has temporarily suspended testing and training requirements with AFFF until the disposal problem has been resolved. At the time of the on-site portion of the Survey, SPR was continuing dialog with the state and investigating disposal options. Subsequent to the on-site portion of the Survey, the Louisiana Department of Natural Resources granted permission for the disposal of AFFF into SPR's saltwater disposal wells (Welsh, 1988). A finding relating to a problem with disposal of this material is presented in Section 6.1.2.4.3.

An abandoned concrete pump pad south of the slop-oil storage tank is used for washing vehicles. Wastewater from this pad, which may contain small amounts of detergents used for washing the vehicles, is conducted to an oxidation pond just east of the pad. The overflow from this oxidation pond is tied into the discharge line from the oil/water separator on the slop-oil tank dike. The discharge from the oxidation pond is not listed in the discharge permit for West Hackberry.

6.1.2.2.2. Brine Disposal

Brine from the caverns, during leaching and filling operations, is piped to the anhydrite pond for insoluble material (anhydrite) to settle out and any entrapped oil to float to the surface. It then flows into the brine pond for additional settling and oil removal, if needed, before being disposed of through injection into wells or being pumped to the Gulf of Mexico. The brine is pumped to the Gulf of Mexico at a rate that allows the exit velocity through the individual diffusers to meet or exceed the NPDES permit limit of 25 feet/second. This rate has been established to permit adequate mixing with the sea water. If this is not done, a high salinity lens could develop on the floor of the Gulf in the diffuser area because the density of the brine discharge is greater than that of the sea water. The use of the injection wells (Section 6.1.3.1.1) allows for greater flexibility in the brine disposal rate.

Oil/brine separators were installed ahead of the brine pond in the original design of the brine handling system, but are no longer used. The site has determined that the oil can be removed just as

effectively, by booms placed in the brine ponds, without encountering the difficulties in keeping the anhydrite cleaned out of the separators. Booms in the ponds retain the oil so that it can be sucked off and hauled to the slop oil tank for reinjection into the system.

The insoluble material that settles in the ponds is dredged out and put into the adjacent insoluble material pond for dewatering and disposal in place (Section 6.2.1.2).

The NPDES permit requires that the integrity of the brine line to the Gulf of Mexico be tested every 6 months. It is not feasible to do this hydrostatically, since it would require that the diffuser ports situated on the floor of the Gulf be closed off for each test. An alternative method utilizing duplicate calibrated flow meters, installed in the brine line at the site and also in the first diffuser in the Gulf, is being tested here. If approval is obtained from the EPA, this method will also be used at Bryan Mound.

6.1.2.2.3 Sanitary Sewage

The sanitary sewage at West Hackberry is treated in an extended aeration, activated sludge, package sewage treatment plant (sampling location 002 in Figure 6-4) located across the road, west of the Motor Control Center (MCC). This unit has a rated capacity of 1,500 gpd with an average present loading of 1,425 gpd. Sand filters are installed between the packaged sewage treatment plant and the chlorine contact chamber. These filters increase the efficiency of the plant by removing suspended material which does not settle in the clarification chamber of the treatment plant. The effluent from the system flows into a drainage ditch that discharges into Black Lake. The solids that are collected on the filters are either scraped off into plastic bags for disposal at a sanitary landfill, or vacuumed for disposal of the Lake Charles municipal plant.

Sanitary wastes from the guard station at the main gate and the emergency control center are collected in sumps that are pumped out twice per week by a sanitary waste disposal contractor for off-site disposal at a municipal wastewater treatment plant.

FIGURE 6-4

SURFACE-WATER SAMPLING LOCATIONS AT WEST HACKBERRY STRATEGIC PETROLEUM RESERVE

6.1.2.2.4 Storm Water

Storm water from the site runs into Black Lake from areas that are north of the maintenance shop and MCC area and into the saltwater marshes south of the site from those areas that are south of these buildings. Those areas (such as the cavern wellpads, meter prover pad, and pump pads) that have the greatest potential for spilling oil or brine are diked and the storm water collected/contained in these areas is discharged through oil/water separators. The oil/water separators at West Hackberry well and tank pads are operated in a batch mode. That is, when a storm occurs, the water contained in the dike is analyzed. Only if the dike water meets the discharge limits (Section 6.1.2.3.1) is it allowed to be discharged. If it does not meet discharge limits, appropriate action would be taken. Skimming oil from the water in the dike prior to discharge (to reduce the load on the oil/water separator), or removing the water to the brine pond (if it has a high salinity), are examples of actions that might be taken.

6.1.2.3 Environmental Monitoring Program

6.1.2.3.1 NPDES Monitoring

The surface water discharges at West Hackberry are regulated by NPDES Permit LA0053031, which was issued by the U.S. Environmental Protection Agency (EPA) on August 22, 1984 with an expiration date of August 21, 1989. Correspondence in the SPR file shows that applications for permit renewals were transmitted both to EPA and the state on March 30, 1984. However, the Louisiana Department of Environmental Quality (LDEQ) has issued no numbered permits or renewals. The only record of a state permit for the site is a letter dated June 18, 1979 saying that the Stream Control Commission had granted the site a permit to discharge rainwater and treated sanitary wastewater at its meeting on March 30, 1979. This letter sets limits for oil and grease, total suspended solids, and biochemical oxygen demand that are identical to those listed in the NPDES permit for these wastes. The letter mentions no expiration date and says that the proposed off-shore brine discharges will be reviewed.

The NPDES discharge monitoring locations are listed in Table 6-3 and shown on Figure 6-4. The actual discharge point for Outfall 001 (brine discharge) is 5 miles offshore in the Gulf of Mexico, although the samples are taken on-site at the high-pressure pump pad. The designated sampling point for each of the storm-water runoffs from the cavern pads is at the discharge from the oil/water separator. However, in order to assure the discharge of only water that meets the limits in the permit, the site samples water contained on the pad and only releases it through the separator, if it meets the criteria. The parameters, discharge limits, and sampling frequency for each of the outfalls

TABLE 6-3

WATER SAMPLING LOCATIONS
WEST HACKBERRY SITE
STRATEGIC PETROLEUM RESERVE

NPDES Discharge Monitoring Stations	
001	Brine Disposal
002	Discharge from Sewage Treatment Plant
Storm-Water Discharges Storm-Water and Pump Flush from High-Pressure Pump Pad Storm-Water Runoff from Well Pads 6-9, 11, and 101-117	

Water Quality Monitoring Stations	
A	Black Lake
B	Black Lake
C	Black Lake
D	Southeast Drainage Ditch
E	High-Pressure Pump Pad
F	Raw-Water-Intake Structure

Source: BPS, 1987h.

are listed in Table 6-4. The only exceptions to permit conditions, in 1986, were a missed sample at both Outfalls 001 and 002, a BOD at Outfall 002 (sewage treatment plant) that was 17.5 mg/L as compared to a limit of 15.0 mg/L, an oil and grease value of 150 mg/L at Outfall 001 versus a limitation of 15.0 mg/L (due to lubricant contamination at the sampling port), one nondetectable dissolved oxygen in the brine line discharge, and one occurrence of low pH (5.98 versus 6.0) due to low pH of the raw water used for leaching.

6.1.2.3.2 Surface-Water Monitoring

Although there are no permit requirements to do surface-water monitoring, West Hackberry takes samples of waters in Black Lake, an on-site drainage ditch, raw water intake structure (RWIS), and the ditch adjacent to the site to monitor any impact that the site may have on these bodies of water. The results of these analyses are summarized in the Annual Environmental Monitoring Report prepared by BPS for SPR-PMO. The surface-water sampling locations are identified with the letters on Figure 6-2, as opposed to the NPDES sampling locations which are identified by their numbers.

Surface-water parameters measured at West Hackberry include pH, salinity, total suspended solids (TSS), temperature, total organic carbon (TOC), and oil and grease. During 1986, the pH of all stations ranged from 7.3 to 8.2 S.U. with the median being 7.6 S.U. Salinity averaged 6.8 ppt and ranged from 0.2 ppt to 21.0 ppt. TSS averaged 32.4 mg/L and ranged from 1.0 to 225.5 mg/L. The temperature in Black Lake samples averaged 24.2°C and ranged from 9.0 to 34.0°C. Oil and grease values were below the detectable limit of 5 mg/L at all stations throughout 1986. TOC was measured only at Station B, the drainage area for discharges from the high-pressure pump pad. Levels ranged from nondetectable to 5.3 mg/L and averaged 1.7 mg/L. The location of these surface-water samples are also listed in Table 6-3 and shown in Figure 6-4. The sampling results indicate no adverse long-term affect on the adjacent surface water from the site operations. This is in spite of the blow-out at Cavern Pad 111 (Sections 6.2.2.1.2 and 6.2.5.2.8) that occurred in 1986, resulting in the release of crude oil and brine into Black Lake and surrounding areas. The report prepared on this release by DOE indicates that environmental damage resulting from this release was "minimal" (DOE, 1986b).

6.1.2.4 Findings and Observations

6.1.2.4.1 Category I

None.

TABLE 6-4

DISCHARGE MONITORING REQUIREMENTS AND EFFLUENT LIMITATIONS
WEST HACKBERRY SITE
STRATEGIC PETROLEUM RESERVE

Outfall	Parameter	Minimum	Daily Average	Daily Maximum	Measurement Frequency ⁽¹⁾	Sample Type
001 Brine Discharge to Gulf of Mexico	Flow	N/A ⁽²⁾	N/A	45.7 mgd	Continuous	Recorded
	Oil & Grease	N/A	10 mg/L	15 mg/L	1/day	Grab
	Total Suspended Solids	N/A	Report	Report	1/day	Grab
	Total Dissolved Solids	N/A	Report	Report	1/day	Grab
	pH	6.0 S.U.	N/A	9.0 S.U.	1/month	Grab
	Dissolved Oxygen ⁽³⁾ Oxygen Scavenger	Detectable N/A	N/A N/A	N/A 10 ppm NH ₄ HSO ₃ /ppm DO or 18 ppm K ₂ SO ₃ /ppm DO	1/day ⁽³⁾ None given	Grab Calculation
002 Sewage Treatment Plant Discharge	Flow ⁽⁴⁾	N/A	N/A	N/A	1/month	Instantaneous
	Biochemical Oxygen Demand	N/A	10 mg/L	15 mg/L	1/month	Grab
	Total Suspended Solids	N/A	30 mg/L	45 mg/L	1/month	Grab
	Fecal Coliform ⁽⁴⁾	N/A	Report	Report	1/month	Grab
	pH ⁽⁴⁾	6.0 S.U.	N/A	9.0 S.U.	1/month	Grab
Storm-Water Runoff	Oil & Grease	N/A	N/A	15 mg/L	1/day	Grab
	Total Organic Carbon ⁽⁴⁾	N/A	N/A	75 mg/L	1/day	Grab
	pH ⁽⁴⁾	6.0 S.U.	N/A	9.0 S.U.	1/day	Grab

Source: NPDES Permit No. LA0053031

- (1) When discharge is occurring
 (2) Minimum nozzle exit velocity at the diffuser shall be 25 feet per second.
 (3) When oxygen scavenger is being used.
 (4) Federal requirement only.

6.1.2.4.2 Category II

None.

6.1.2.4.3 Category III

1. Potential Oxygen Depletion of Nearby Surface Water From the Discharge of Aqueous Film Forming Foam (AFFF). AFFF is used throughout the SPR, because it is effective in covering and thus extinguishing hydrocarbon liquid-based fires. The release of untreated AFFF into surface waters can have an adverse impact on surrounding wetlands. Although the materials available at the SPR sites will vary slightly in composition, they are characteristically classified by the manufacturers as being biodegradable and practically non-toxic, having an LD₅₀ greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered.) These materials also contain fluorocarbon surfactants (5 percent or less) that are not biodegradable. AFFF materials exhibit varying degrees of aquatic toxicity and have a high biochemical oxygen demand (BOD) and chemical oxygen demand (COD). Therefore, AFFF, if discharged to adjacent surface water could result in temporary oxygen depletion in those waters in addition to being toxic to some aquatic species. Although there is no restriction on its use in emergency situations, state regulatory agencies require that it be treated prior to discharge when used in training or performance tests. This creates a disposal problem. Under optimum conditions, sewage treatment plants of the types installed at the SPR sites can effectively treat waste AFFF material; however, 18,967 gallons of waste AFFF are expected to be generated annually during training exercises and performance tests at West Hackberry. The treatment plant could handle only an estimated 456 gallons per year. Subsequent to the on-site portion of the Survey, permission was received from the state to dispose of AFFF into SPR's saltwater disposal wells (Welsh, 1988). However, the use of AFFF for training and performance testing purposes has been temporarily curtailed until the waste disposal issue is adequately addressed.

6.1.2.4.4 Category IV

1. Discharge Not Included on NPDES Permit. The discharge from the oxidation pond is not included in the site's NPDES permit. This pond was installed to retain and allow biodegradation of oil and grease and surfactants that may be discharged from an adjacent vehicle wash pad. Effluent from this pond discharges into a drainage ditch, which eventually runs off-site. This point-source discharge from the pond is not included in the site NPDES discharge permits.

2. Unapproved Use of Backflow Preventer. A potable water line, equipped with backflow preventers, is cross-connected to an industrial water well line that supplies the seal-flush water tank. In the State of Louisiana, the use of backflow preventers is not approved for cross-connections between potable and nonpotable water lines. A 6-inch air gap is the stated regulatory requirement. This is to assure that nonpotable water will not enter a potable water system, which might occur if a backflow preventer would fail. At the time of the on-site Survey, the industrial water well was not being used because the pump was broken. Therefore, there was no immediate threat to the potable water system.

PRELIMINARY

6.1.3 Groundwater/Soil

6.1.3.1 Background Environmental Information

6.1.3.1.1 Site-Specific Geology and Hydrogeology

The West Hackberry salt dome is part of a salt ridge that includes both the East and West Hackberry domes. At the West Hackberry SPR site, the top of the salt is approximately 2,000 feet (610 meters) below the ground surface. Caprock is present from a depth of 1,500 feet (460 meters) below the surface to the top of the salt. Unconsolidated sedimentary deposits of the Holocene and Pleistocene Ages are present from the ground surface to the caprock. Water-bearing sands within these sedimentary deposits form the Chicot aquifer system.

The principal water-bearing sands of the Chicot aquifer occur at depths of approximately 200 feet, 500 feet, and 700 feet. The Chicot aquifer is the principal source of groundwater in the site area and is used for domestic and livestock supplies, industrial purposes, and rice irrigation. The aquifer is predominantly fresh water, with salinity increasing towards the Gulf coastline. In the site area, the freshwater/saltwater interface is approximately 700 feet (210 meters) below the surface. Extensive groundwater pumping from the Chicot aquifer takes place in the Lake Charles area, located to the north of West Hackberry. The pumping is so great that the groundwater gradient has been reversed locally, so that groundwater flows from the south to the north rather than southward to the Gulf.

Shallow aquifers of the Pleistocene Age, composed of oyster shells and associated silty sands, are found at depths of less than 100 feet (30 meters). These aquifers usually yield small quantities of water (less than 100 gallons per minute) for domestic and rural supplies. The shallow aquifer sands are normally thin and intermittent but, because of their proximity to the surface, these aquifers are relatively significant to the West Hackberry SPR Site. The material overlying these aquifers is often silty to sandy and, therefore, will transmit fluids, although slowly. In the event of a spill at the West Hackberry SPR Site, these shallow aquifers would potentially be the ones most affected. There is very little information available concerning the shallow aquifers, except that they provide much of the local domestic water supply.

Hydraulic communication between the shallow sand aquifers and the "200-foot" sand is probably low, due to intervening confining layers. Some communication probably occurs along fault planes induced by continued domal growth within the salt (Whiting, 1980). It is likely that a high degree of communication exists locally between the shallow-sand aquifer and lakes, streams, and marshlands.

Information on shallow subsurface sedimentary deposits is available from soil borings taken in 1977 by Law Engineering Testing Company, prior to construction of the brine and raw water holding ponds at the site. In general, sandy silts and silty sands are present to a depth of at least 30 feet, which was the maximum depth of the 1977 soil borings. Clays, with occasional thin layers of silt or sand, are present below this depth. There is some indication that the clays serve as a hydraulic barrier to vertical migration of groundwater, because the water level in a single well completed beneath the clay differs from those measured in more shallow wells. On the basis of one round of water level measurements in three shallow wells, groundwater flow in the uppermost shallow sand aquifer is to the northeast.

6.1.3.1.2 Groundwater Use

Near the West Hackberry SPR site, a municipal water system serves the town of Hackberry and surrounding areas. This water supply consists of two wells. Well No. 1 has a total depth of 530 feet and Well No. 2 has a total depth of 653 feet. The combined yield of the two wells is 200,000 gallons per day (SPRO, 1978b). Despite the existence of this water system, many existing private wells remain in operation for stock water or watering lawns. These wells range in depth from less than 50 feet to greater than 250 feet. The nearest well to the site is located to the east about 0.2 mile. The well is allegedly not in use (PB-KBB, 1987). Three inactive drinking water wells at the southern end of the site are scheduled for plugging and abandonment. An active industrial well 380 feet deep is present on-site (see Section 6.1.2.1.2, Sources of Water Used at the Site).

Methane and iron may create problems in the use of groundwater as a potable water source. Methane concentrations as high as 100 ppm have been found in a well 2 miles south of the site (Whiting, 1980). The iron content of groundwater is usually less than 1 mg/L, but locally may reach 8.5 mg/L. The secondary drinking water standard for iron is 0.3 mg/L. Iron at higher levels may cause staining, but is not considered a health hazard.

6.1.3.2 General Description of Pollution Sources/Controls

6.1.3.2.1 Brine Disposal Wells

Ten brine disposal wells (SWD 1, 1A, 1B, 1C, 2, 2A, 2B, 2C, 2D, and 2E), owned and operated by DOE, are located on two wellpads approximately 2 miles southeast of the site. Two of these wells, SWD 1 and 1C, are temporarily plugged; eight are currently active. Brine from West Hackberry is usually disposed of through the brine pipeline to the Gulf; however, these injection wells are used as needed. For example, the 36-inch brine pipeline failed on December 8, 1985. All produced brine

went to the injection wells until brine pipeline repairs were completed in mid-1986. As a result, the total volume of brine disposed of in these wells increased from 275,509 barrels in 1985 to 12,139,125 barrels in 1986.

The major groundwater concern from brine disposal well operations is leakage of brine into freshwater aquifers overlying the brine disposal sands. Such cross-contamination between aquifers is prevented by periodic testing of disposal well integrity. Records for such testing were reviewed during the on-site Survey. It appears that the regulations for integrity testing are strictly enforced by the state and all requirements are met by the SPR. For example, brine disposal well SWD 1 was temporarily plugged in 1984, because it did not pass the pressure inspection test required by Louisiana Statewide Order 29-B. Temporary plugs are used for wells which would require major workovers for restoration to service. Work permits are issued by the state for such repairs. Several attempts were made during 1987 to reactivate SWD 1C, but these were apparently unsuccessful. When a decision is finally made to remove this or any other disposal well from service permanently, plugging and abandonment would follow the requirements of Louisiana Statewide Order 29-B.

6.1.3.2.2 Abandoned Holes and Caverns

Abandoned caverns from past brining operations are known to exist at the West Hackberry SPR Site. Olin Corporation and its predecessors have been producing brine as feedstock for soda ash plants since 1934. Five of the caverns, derived from their brine operations, formed the initial storage sites for the SPR program at West Hackberry. These were Caverns 6, 7, 8, 9, and 11. Abandoned Olin Cavern 4 is located beneath the brine and anhydrite ponds. This cavern, as well as Olin Caverns 1, 2, 3, and 5 (off-site), were constructed prior to the development of sonar caliper surveys for leaching operations. There was little control on leaching conditions and all these abandoned caverns were leached into the caprock (Whiting, 1980). Olin No. 3 has coalesced with Olin No. 4. The Olin No. 4 wellhead is under investigation as a possible source for brine contamination found in groundwater at West Hackberry. This potential problem is discussed in Section 6.1.3.3 and Finding 6.1.3.4.3.

6.1.3.2.3 Anhydrite/Brine Ponds

The pond system originally constructed at West Hackberry consisted of a raw water holding pond to the north and a brine holding pond to the south. Brine from leaching operations passed through oil/brine separators west of the ponds and, then, into the brine pond.

The raw water pond was later divided to form a smaller raw water pond to the west and an anhydrite pond to the east. Brine from leaching operations went directly to the anhydrite pond,

which functioned as an oil/brine separator and anhydrite collection pond. After an appreciable quantity of anhydrite (about 50,000 barrels) had accumulated, the flow of brine was diverted to the brine pond and raw water from the Intracoastal Waterway was used to wash the insoluble anhydrite and silicates. When the chloride level of leachate or runoff had reached 16 ppt or less, a limit reached by agreement with the EPA, the washed anhydrite was considered suitable for fill or construction material. Washed anhydrite was removed from the anhydrite pond and used to fill a borrow pit north of this pond. The volume of anhydrite subsequently generated was greater than the amount that could be used for fill and therefore two anhydrite disposal pits were constructed. A third anhydrite disposal pit was created south of the brine pond.

Salinity increases observed in 1987 in a monitoring well east of the brine pond (see Section 6.1.3.3) may be due to leakage from the pond. There are cracks in the concrete, tears in the liner, and fluid containing weathered oil in the substrate beneath the liner (Teerling, 1987i). The liner is deteriorated near the top of the pond, where it is exposed to sunlight. Leakage from this pond would be a violation of Statewide Order 29-B. Investigation of possible leakage is in progress, as described in Section 6.1.3.3 and Finding 6.1.3.4.3.

6.1.3.3 Environmental Monitoring Program

At the time of the on-site Survey, four monitoring wells existed at the West Hackberry Site. Three of these, PB, P9, and P11, are also called 8A, 9A, and 11A on older documents. They appear to be part of a more extensive set of wellpad piezometers, which included 7A, 7C, 8C2, 9C2, and 11C at wellpads 7, 8, 9, and 11. Only PB, P9, and P11 still exist. Construction details are unavailable for these older piezometers. However, they are thought to be completed in the shallow silty sand found at depths less than 35 to 40 feet at the site. The basis for this statement is a comparison of the estimated depths of these wells with a borehole log of the fourth well, PB1. Well PB1 was installed later (1981) and completed in a deeper unit, which is a fine sand, present at a depth of 40 to 50 feet. PB1 was installed near the brine pond to provide background groundwater data as part of disposal plans for insolubles (e.g., anhydrite and various silicate minerals).

Routine monitoring of these piezometers has been carried out since 1982, although isolated chloride analyses from 1981 have been reported. These 1981 chloride values are 63 mg/L at PB1, 2,500 mg/L at P9, and 22,000 mg/L at P11 (PB-KBB, 1987). Fresh water is usually defined as water containing less than 250 mg/L chloride (Whiting, 1980). The 1981 analysis at PB1 is the only value that falls within the fresh water range. Sea water is 10,000 to 30,000 mg/L chloride (Whiting, 1980). Corresponding salinity values are 0-0.2 parts per thousand (ppt) for fresh water, 0.2-10 ppt for brackish water, and 10-35 ppt for saline water. Saturated brine can reach 250 ppt salinity.

In general, the shallow groundwater at West Hackberry is brackish. Salinity levels at P8 range from 0.9 to 6.4 ppt, with a cumulative mean of 2.5 ppt. Since 1982, salinity levels at P9 have ranged from 1.5 to 6.9 ppt. During the latter part of 1982, salinity at P9 was as high as 14.8 ppt. This high level is thought to be due to leakage from the brine system at the high-pressure pump pad south of P9. Surface water monitoring at Station E on the drainage ditch, from the high-pressure pump pad to Black Lake, indicated salinity levels as high as 45 ppt (POSSI, 1983). The problem of chronically leaking flanges on the brine line at the pump pad was eventually corrected and salinity values at Station E were reduced to 0.8-2.1 ppt during 1985. Groundwater quality showed a corresponding improvement at P9, although the improvement was not noticeable until 1986. Salinity levels at P11 ranged from 3.1 to 7.1 ppt.

No trends are apparent in the data for piezometers P8, P9, and P11, other than the reduction in salinity already discussed for P9.

The situation is considerably different for PB1. This well monitors a deeper sand unit that is separated from the uppermost brackish water-bearing sand unit by a clay layer. In addition to the 1981 analysis, which indicated chloride in the fresh water range, early salinity analyses in 1982 were 0-1.5 ppt. However, salinity levels in this well have increased steadily, reaching an average of 8.9 ppt in 1984 and 14 ppt in 1986. In 1987, salinity levels jumped to 61-77 ppt. A chloride analyses from a May 7, 1987 sample was 122,579 mg/L. For comparison, brine in the brine pond had a chloride level of 195,886 mg/L.

The source of contamination found in PB1 may be leakage from the anhydrite/brine pond system, leakage from an abandoned cavern (Olin No. 4), or both. Installation of eight new monitoring wells was completed in January 1988, in an SPR effort to identify the source and possible extent of contamination. The shallow wells in this series are approximately 30 feet deep and completed above a clay layer. The deeper wells are approximately 50 feet deep and screened in a deeper sand below the clay layer. These deeper wells should be comparable to PB1. All wells are 4-inch PVC. Neither protective steel surface casings nor locking caps were used, so that these new wells are somewhat vulnerable to damage and potential contamination. They will probably survive long enough for their intended purpose of short-term source identification.

Preliminary measurements of salinity in these new wells indicate that five of the eight wells may have brine contamination. Well locations are shown on Figure 6-5. Well P3-D, which is comparable to PB1, shows no contamination. However, the associated shallow well P3-S at this location has salinity levels as high as 87 ppt. No explanation for the differences between PB1 and the P3 well

cluster is yet available. One possible explanation is that PB1 may be damaged and may be actually receiving flow from the shallow, rather than the deeper sand unit. PB1 recharges rapidly after purging, although the other deep wells produce very little water.

Wells southwest (P1-D and P1-S) and southeast (P4-D and P4-S) of the brine pond indicate both shallow and deeper brine contamination. The highest level found was 171.6 ppt in P1-S, a 30-foot-deep well southwest of the brine pond. These preliminary observations suggest that a more generalized problem may exist, rather than a single plume east of the ponds. Further rounds of sampling are needed to confirm the pond system as the source.

Groundwater sampling procedures were demonstrated by site personnel during the on-site Survey. Groundwater sample collection practices at West Hackberry do not adhere to standard procedures recommended by the EPA for more stringent hazardous waste monitoring, specifically in regard to equipment cleanliness, field measurement, and documentation. No written procedures exist. Both purging and sampling are done with a portable Masterflex sampling pump, which should be adequate for the gross salinity-type measurements being performed. A bailer would prevent loss of dissolved gases, if this parameter were of interest. Purging is done on a time basis rather than a volume basis. No attempt is made to keep the pump and lines from touching the ground. This practice could introduce surface contamination into the well.

Water levels are not routinely measured; absence of this information could interfere with interpretation of the analytical data obtained. However, none of the practices observed are likely to compromise the validity of gross salinity analyses.

6.1.3.4 Findings and Observations

6.1.3.4.1 Category I

None.

6.1.3.4.2 Category II

None.

FIGURE 6-5

GROUNDWATER MONITORING WELLS NEAR BRINE POND AT WEST HACKBERRY STRATEGIC PETROLEUM RESERVE

6.1.3.4.3 Category III

1. Salinity Increase in Groundwater. A sudden increase (from October 1986 to February 1987 sampling rounds) in salinity from 16.0 ppt to 77 ppt has been observed in groundwater at monitoring well number PB1 (about 50 feet deep). This well is located adjacent to the anhydrite/brine pond system and an abandoned cavern wellhead (known as Olin No. 4) that is under a portion of the concrete-covered diking around the pond system. Background salinity levels in this area should be less than 10 ppt. The source of the contamination is currently unknown, but may be leakage from the pond system, the wellhead, or both. A resistivity survey conducted by the site indicated that the high salinity was not present in the near-surface groundwater, but was present at greater depth. Since the brine pond would be expected to leak into the near-surface groundwater, this suggests that the source of contamination may be the cavern wellhead. This cavern was plugged according to practices considered adequate in the 1950s, with two intervals of cement, 0-50 feet and 1,105-1,205 feet in depth (Whiting, 1980). If the source of leakage is shown to be the wellhead, state regulations require replugging.

The dike between the anhydrite and brine ponds is badly cracked, with the concrete displaced in some areas and the liner deteriorated near the top of the dike, where it is exposed to sunlight. This condition and observations by site personnel lead to the concern that the pond floors and walls may also be damaged and leaking. (The brine pond has a capacity of 300,000 barrels (12.6 million gallons) and dimensions of 560 feet by 360 feet by 6 feet. The anhydrite pond has dimensions of 380 feet by 360 feet by 6 feet).

Installation of eight new monitoring wells was completed in January 1988 in an SPR effort to identify the source and possible extent of contamination. Preliminary measurements of salinity indicate that five of the eight new wells may have brine contamination (Huff, 1988c). Wells east of the brine pond system near the abandoned cavern wellhead and near monitoring well PB1, show shallow (about 30 feet deep) contamination (at levels as high as 81 ppt), which does not confirm the results of the resistivity study. Wells southwest and southeast of the brine pond indicate both shallow and deeper brine contamination. The highest level found was 171.6 ppt in P1-S, a shallow (30-foot deep) well southwest of the brine pond. These preliminary observations suggest that a more generalized problem may exist, but further rounds of sampling are needed to confirm the pond system as the source. Leakage of the pond system would constitute a violation of Louisiana Statewide Order 29-B, which prohibits such leakage.

6.1.3.4.4 Category IV

1. Inadequate Groundwater Sampling Procedures. No written sampling procedures exist for groundwater monitoring wells at West Hackberry. Actual sample collection practices do not adhere to standard procedures recommended by the EPA, specifically in regard to equipment cleanliness, field measurement, and documentation. Both purging and sampling are done with a portable Masterflex sampling pump, which should be adequate for the gross salinity-type measurements being performed. A bailer would prevent loss of dissolved gases, if this parameter were of interest. Purging is done on a time basis rather than a volume basis. No attempt is made to keep the pump and lines from touching the ground, and this practice could introduce surface contamination into the well.

Water levels are not routinely measured; absence of this information could interfere with interpretation of the analytical data obtained. However, none of the practices observed are likely to compromise the validity of gross salinity analyses.

2. Inactive Water Wells. At West Hackberry, three inactive drinking-water wells at the southern end of the site may require plugging and abandonment in accordance with state regulations. (Louisiana Department of Transportation and Development, Office of Public Works, Water Resources Section, R.S. 38:3091 through 38:3097, effective November 1, 1985).

The statutes require the following actions: Water wells and monitoring (observation) wells must be plugged and sealed within 90 calendar days after abandonment. A water well is abandoned if its use has been permanently discontinued; its pumping equipment permanently removed; the well cannot be used to supply water or has the potential for submitting surface contaminants into the aquifer; the well poses a potential health or safety hazard; or, the well cannot be placed in the active, standby, or inactive status mode. A monitoring well is abandoned when it is no longer needed for observation purposes and the owner does not intend to convert it to an active status.

6.2 Non-Media-Specific Survey Findings

This section discusses findings and observations pertaining to waste management, toxic and chemical materials, radiation, quality assurance, and inactive waste sites and releases. These discussions do not include a background environmental information section, because the areas addressed are not necessarily tied to one medium as was the case with the discussions in Section 6.1. These discussions include an environmental monitoring program section, where appropriate and where information was available.

6.2.1 Waste Management

6.2.1.1 Background Information

Operations at the West Hackberry site generate nonhazardous oilfield wastes, nonindustrial solid wastes, and small quantities of hazardous wastes. The site does not generate any industrial solid wastes, radioactive wastes, or radioactive/hazardous mixed wastes. Brief descriptions of all these wastes are as follows:

- Nonhazardous oilfield wastes are wastes generated by the drilling and production of oil and gas wells and which are not regulated by the provisions of the Louisiana Hazardous Waste Rules (LHWR) (Louisiana Statewide Order No. 29-B). Oilfield wastes include drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy [LHWR 1.3(d)(14)].
- Industrial solid wastes are wastes produced in the course of and resulting from any industrial, manufacturing, or mining process, and which are not subject to regulation under the Louisiana Hazardous Waste Management Plan. Trash, construction debris, and other non-process wastes are not considered industrial solid wastes (Louisiana Solid Waste Regulations, Chapter 3.0).
- Nonindustrial solid wastes include any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from commercial and agricultural operations, and from community activities; but does not include or mean solid or dissolved material in domestic sewage or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under Louisiana Revised Statutes (LA R.S.) 30:1094, or source, special nuclear, or

by product material as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended, or hazardous waste subject to permits under LA R.S. 30:1131 et seq. (Louisiana Solid Waste Regulations, Chapter 3.0).

- Hazardous wastes include any wastes or combination of wastes, which because of their quantity, concentration, physical, chemical, or infectious characteristics may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Such definition shall be applied only to those wastes identified and designated as such by the Department of Environmental Quality, consistent with applicable Federal laws and regulations (Louisiana Hazardous Waste Control Law, LA R.S. 30:1133).
- Radioactive wastes are wastes containing radioactivity (i.e., materials that emit radiation, such as alpha and beta particles, neutrons, electrons, and gamma rays).
- Mixed (radioactive and hazardous) wastes are co-contaminated with radioactive and hazardous waste materials.

Nonhazardous oilfield wastes are regulated by the Louisiana Department of Natural Resources Office of Conservation (LOC). Generators are responsible for the proper handling and transportation of these wastes to an approved facility [Louisiana Statewide Order No. 29-B, Subparagraph 13.2(A)]. All shipments of oilfield wastes for off-site disposal must be accompanied by a properly completed LOC manifest, entitled Oil Field Waste Shipping Control Ticket, that is initiated by the generator (Louisiana Statewide Order No. 29-B, Subparagraph 13.6). Generators must use haulers that are registered with the Louisiana Public Service Commission to transport oilfield wastes. Because some oilfield wastes generated at West Hackberry are disposed of into underground injection wells, the following regulations must also be met (Allison, 1983):

- Preparation of annual injection well monitoring reports;
- Demonstration of the annular integrity of the disposal wells every 5 years;
- LOC site inspections twice a year; and
- Notification to LOC regarding any pertinent changes or losses, including new well completions, well start-ups, well conversions, and well abandonments or losses that can affect the freshwater aquifers.

In addition, ponds and pits used to hold or dispose of oilfield wastes, such as the anhydrite pond, brine pond, and anhydrite disposal pits at West Hackberry, must be registered, operated, and closed in compliance with Section XV Subparagraphs 2.3 through 2.7 of Louisiana Statewide Order No. 29-B.

Oilfield wastes are temporarily exempted from regulation as hazardous wastes under Section 3001(b)(2)(A) of the 1980 Amendments to RCRA, pending further study by EPA. After submission of study results to Congress, and public hearings and opportunity to comment, the Administrator of EPA must determine either to promulgate regulations under the hazardous waste management provisions of RCRA (Subtitle C) or to declare that such regulations are unwarranted. Because wastes generated from activities associated with underground storage of hydrocarbons are considered oilfield wastes, the temporary exemption applies to the West Hackberry oilfield wastes. Exempted wastes are defined in detail in the Report to Congress, Management of Wastes from the Exploration, Development, and Production of Crude Oil, Natural Gas, and Geothermal Energy (EPA, 1987a), as well as in the Louisiana Hazardous Wastes Rules and Regulations [LHWR 1.3(d)(14)].

Nonindustrial solid wastes are regulated by the Louisiana Department of Environmental Quality (LDEQ) Solid Waste Management Division. Generators of these wastes are not required to use manifests for off-site shipments (Louisiana Solid Waste Regulations). Because none of these wastes are disposed of at West Hackberry, no LDEQ disposal permit is required.

Hazardous wastes are regulated by the LDEQ Hazardous Waste Management Division. Because West Hackberry is a small quantity generator, it is subject to Chapter 21 of the Louisiana Hazardous Waste Rules (LHWR). However, LDEQ does not automatically exempt small quantity generators from the full requirements of the LHWR. Instead, small quantity generators are required to notify LDEQ in writing that they are small quantity generators (LHWR 21.3). Before Louisiana was granted RCRA authority, EPA issued the site generator number LA 2890032582 in response to SPR's 1980 Part A RCRA Section 3005 notification, but then reclassified the site to nonhandler status in June 1982 because it was a small quantity generator (Paul, 1982).

6.2.1.2 General Description of Pollution Sources/Controls

6.2.1.2.1 Nonhazardous Oilfield Wastes

Nonhazardous oilfield wastes generated at the West Hackberry SPR site include brine, anhydrite, fluids from well workover and pipeline cleaning, oily tank bottoms, oily sorbent pads and rags, and oil and brine spill cleanup wastes. Drilling muds and salt cuttings are no longer being generated

because all cavern and brine disposal wells have been drilled. (Past disposal of drilling muds and salt cuttings is discussed in Section 6.2.5.2.) Brine and fluids from cavern leaching, well workover and pipeline cleaning are either disposed of into DOE-owned and -operated underground injection wells located 2 miles southwest of the site or via a brine disposal line that discharges into the Gulf of Mexico about 5 miles off-shore. Anhydrite is removed from the anhydrite pond and disposed of in the on-site anhydrite disposal pits (Figure 6-6). Tank bottoms and cleanup wastes (i.e., oil- or brine-contaminated soils) are shipped to the Campbell Wells commercial disposal site in Mermentau, Louisiana to be land farmed. Oily sorbent pads and rags are temporarily stored in a dedicated dumpster at the oily waste holding/storage area (Figure 6-6) and taken to the BFI Woodland Hills landfill in Sulphur, Louisiana. This landfill is permitted for disposal of all nonhazardous wastes (i.e., oilfield, industrial, and nonindustrial solid wastes). According to site personnel, all oilfield wastes are transported by haulers registered with the Louisiana Public Service Commission to haul such wastes. Manifests reviewed by the Survey team revealed that 143 cubic yards of oily wastes, including sorbent pads and oil-contaminated soil, were shipped to the BFI site during 1987. In addition, more than 735 barrels (30,870 gallons) of oily sludge and wastewater were removed from the slop oil tank, when it was cleaned out in 1987, and shipped to the Campbell Wells site.

The anhydrite pond, brine pond, and three anhydrite disposal pits are all located together on the east side of the facility (Figure 6-6). SPR submitted the required production pit notifications for these ponds and pits to the LOC Injection and Mining Division in July 1986 (Gray, 1986b). Brine is pumped into the anhydrite pond, where the anhydrite settles out and then into the brine pond, where it is held until disposed of. The brine pond has a capacity of 300,000 barrels (12.6 million gallons). Anhydrite is removed from the anhydrite pond every 2 to 3 years and disposed of in the anhydrite disposal pits (also referred to as insolubles pits). Dimensions of the ponds and pits are presented below (Gray, 1986b).

Pond or Pit	Dimensions (feet)
Anhydrite Pond	380 x 360 x 6
Brine Pond	560 x 360 x 6
Anhydrite Disposal Pit #1	250 x 200 x 6
Anhydrite Disposal Pit #2	400 x 175 x 6
Anhydrite Disposal Pit #3	250 x 200 x 6

FIGURE 6-6

LOCATION OF WASTE MANAGEMENT SITES AT WEST HACKBERRY STRATEGIC PETROLEUM RESERVE

At the time of the Survey, Pit No. 2 was almost completely filled, Pit No. 3 had a little capacity remaining, and Pit No. 1 had ample capacity remaining. The installation of a fourth pit was planned (i.e., designs had been drawn). Both ponds and all three pits were constructed on top of compacted silty clay and each has a reinforced Hypalon liner. The anhydrite and brine ponds also had concrete poured over their liners. None of the ponds or pits have an underdrain system to collect brine that might leak through pond liners. Four groundwater monitoring wells are in the area and eight more were planned to be installed (refer to Section 6.1.3.3)

The concrete lining in the anhydrite and brine ponds was cracked. Brine from these ponds may be leaking into the surrounding soil and groundwater if the underlying Hypalon® lining were also damaged. The dike between the anhydrite and brine ponds also was deteriorated, especially the east end which included significant concrete breakage and displacement. Site personnel also indicated that the brine pond may have shifted and that the north and south walls may have become dislocated from the pond floor (also see Huff, 1987c). The concrete breakage and dislocation could have resulted in liner tears. The east end of the dike between the ponds was repaired/patched during summer 1985, but damage (e.g., shifting concrete) occurred subsequently. In November 1987, the site environmentalist reported that dike deterioration was getting worse and that changes could be observed weekly (Huff, 1987d). Salinity levels in groundwater wells also were high. Potential for soil and groundwater contamination from pond leakage is discussed in Section 6.1.3.4.3.

The DOE brine disposal wells are located 2 miles southwest of the main site. Eight are active and discharge to a saltwater aquifer. Two other wells have been plugged, but one of them may be reactivated. Periodically the active wells are acidized to keep the sand formations open (i.e., to remove precipitated salts and to reduce clay swelling). Refer to Section 6.1.3.2.2 for further discussion of brine disposal wells.

6.2.1.2.2 Nonindustrial Solid Wastes

Nonindustrial solid wastes generated consist of a variety of materials, including trash, solids from the sewage treatment plant, used oil, and construction debris. Excavated dirt, dredge spoils, and solids from the screen at the raw-water-intake structure (RWIS), which are not regulated as solid waste (Louisiana Solid Waste Regulations, Chapter 3.0) are also generated on-site. Trash and debris are collected, disposed of in dumpsters located on-site, and taken to the BFI Woodland Hills landfill in Sulphur, Louisiana. Solids from the sewage treatment plant are put into plastic bags and also taken to the BFI landfill. Used oil (e.g., hydraulic and lubricating oils) is often combined with slop oil (i.e., recovered crude oil spilled or leaked during routine operations) in the slop-oil tank and later injected

into the oil storage caverns. Some of the slop oil and used oil also come from the Sulphur Mines SPR (refer to Section 5.2.1.2.2). Some of the used oil is reclaimed or disposed of off-site. For example, 40 barrels (1,680 gallons) of used motor oil was shipped to a recycling facility in Iota, Louisiana in July 1987 (Manifest No. 87-010). Excavated dirt is disposed of in a small area (about 100 feet by 100 feet) located in the northeast corner of the site, just west of the fire training area. Dredge spoils (i.e., sediments) are disposed of at two sites: spoil from around the RWIS is disposed of just west of the RWIS on DOE property, and spoil from the boat slip, located between Caverns 6 and 7, is disposed of in an area (about 200 feet by 200 feet) located in between Caverns 6 and 8.

The disposal area for excavated dirt used to be a borrow pit before dirt was disposed of there. The dirt used to fill the pit is considered unusable, according to site personnel, because it does not meet construction compaction specifications. According to the site environmentalist, some of the fill previously disposed of in the area contained brine and oil. Some construction and spill response refuse, such as plastic sheeting, lumber, and tires, may have also been buried there.

Some of the used oils are stored at the oily waste holding/storage area. At the time of the Survey, the area contained two drums of used motor oil and several open cans of lubricating oil. The cans of lubricating oil contained rainwater and some of the oil had overflowed and stained the ground. The containers were on pallets that were laid on the ground. No curbing existed to contain spills (refer to Section 6.2.2.1.1). In addition, the laydown yard north of the site warehouse contained seven 55-gallon drums of used oil. The drums were on pallets, which were situated on gravel, and had plastic cover tops.

6.2.1.2.3 Hazardous Wastes

West Hackberry generates small quantities of hazardous wastes, including paint wastes and solvents, on a routine basis. Most of the hazardous substances used on-site are consumed. Thus, it appeared to the Survey team that less than 100 kilograms per month of hazardous wastes are generated. However, the site had not notified LDEQ that it had claimed small quantity generator status per LHWR 21.3.

At the time of the Survey, small quantities of hazardous wastes were on-site awaiting removal for off-site disposal. For example, four 5-gallon containers of hardened epoxy were observed on a wooden pallet at the oily waste holding/storage area. According to the site's weekly environmental inspection reports, they had been there since late July 1987 (i.e., more than 4 months prior to the Survey). About 36 cans of paint, nearly empty, also were seen at the workover rig yard. The cans were left open, so that volatile organics in the unused paint would evaporate and the remaining

constituents would harden into a nonhazardous, inert substance that could be disposed of as nonhazardous, nonindustrial solid waste. According to regulations, storage containers should remain closed [LHWR 21.8(d)(3) and 12.4(a)] and treatment to render a hazardous waste nonhazardous requires LDEQ authorization [LHWR 21.8(c)]. Also, none of the containers holding hardened epoxy or waste paints were marked as hazardous, and none had labels with accumulation start times, as required pursuant to LHWR 21.8(d)(1) and (2). In addition, neither storage area had an impervious base that could contain a spill, as required by LHWR 21.8(d)(3) and 12.6.

The solvent most used on-site for degreasing and cleaning is Varsol, which is a flammable petroleum distillate and may be a hazardous waste when spent (EPA Hazardous Waste Number D001) if its flash point is below 140°F. Spent Varsol is not a RCRA-exempt nonhazardous oilfield waste, because it is not derived from crude oil production or storage [LHWR 1.3(d)(14)]. According to site personnel, spent Varsol is collected in vacuum trucks, along with slop-oil and used oil. These oils are pumped into the slop-oil tank. Varsol, slop-oil, and used oil from the Sulphur Mines SPR are also shipped to West Hackberry and disposed of in the slop oil tank. Contents of the slop-oil tank are then injected into the oil caverns. According to site personnel, the site has received verbal approval from LDEQ to mix spent Varsol with crude oil and used oil, (the site is awaiting written approval). No drums of spent Varsol were seen on-site during the Survey.

According to site personnel and records, no wastes recognized by the site as hazardous had recently been sent off-site for reclamation or disposal. However, because the site did not have an adequate system to determine if wastes were hazardous, some hazardous wastes could have been shipped off-site. One hazardous waste shipment and two toxic wastes shipments had been previously manifested by SPR (Little, 1986):

- Two gallons of benzene and 1.5 gallons of benzyl chloride from the site laboratory were shipped by SPR to the Chemical Waste Management site in Carlyss, Louisiana in 1984.
- Thirty-two 55-gallon drums of PCB-contaminated oil and rags generated during decontamination of two PCB-contaminated transformers, were transported by CECOS to the ENSCO incinerator in El Dorado, Arkansas in 1984.
- Six 55-gallon drums of PCB-contaminated soil and one PCB-contaminated transformer were removed by Bath Electric Service and taken to the PCB, Inc., facility in Kansas City, Kansas, in 1985.

6.2.1.2.4 Underground Storage Tanks

There are three underground storage tanks (USTs) at the West Hackberry SPR facility, according to SPR's tank notification form submitted to the State pursuant to RCRA Subtitle I requirements (Teerling, 1986d). Two are located in the high-pressure pump pad area. One has a 793-gallon capacity and is intended to collect slop oil from the pig launcher/receiver. The other has a 1,008-gallon capacity and is intended to collect slop oil from the meter-proving station. Neither tank has been used to store wastes. Oil collected from the USTs is reinjected into the cavern system. Both tanks are made of steel, and the larger one has cathodic protection. The third tank is a 6,006-gallon, cathodically protected steel tank. At the time of the Survey, the tanks were less than 8 years old. While, SPR does not have a leak detection program for USTs, the potential for UST leakage at West Hackberry appeared to be low and does not present a significant environmental risk at this time.

6.2.1.3 Findings and Observations

6.2.1.3.1 Category I

None.

6.2.1.3.2 Category II

None.

6.2.1.3.3 Category III

None.

6.2.1.3.4 Category IV

1. Noncompliance with Louisiana Hazardous Waste Regulations for Small Quantity Generators. West Hackberry generates small quantities of three hazardous wastes on a routine basis that were identified by the Survey team (i.e., waste paint, epoxy, and spent Varsol, a flammable solvent). These wastes are not managed in compliance with Chapter 21 of the Louisiana Hazardous Waste Rules (LHWR), which require that the generator notify LDEQ that it has claimed small-quantity-generator status, accumulate hazardous waste in properly marked containers on impervious surfaces, and properly dispose of hazardous waste materials.

Even though the site is a small quantity generator (i.e., less than 100 kilograms of hazardous wastes are generated per month), it is not exempt from all LHWR, because the wastes are routinely generated and are not RCRA-exempt oilfield wastes (see LHWR 1.3(d)(1) and (14)). As a small quantity generator, the site is required to notify LDEQ that it has claimed small quantity generator status per LHWR 21.3. According to SPR personnel, no notification had ever been submitted to LDEQ.

Waste management practices were also deficient. For example, four 5-gallon containers of hardened epoxy were observed on a wooden pallet at the oily waste holding/storage area. About 36 cans of paint, nearly empty, were seen at the workover rig yard. The paint cans were left open so that volatile organics in the unused paint would evaporate and the remaining constituents would harden into a nonhazardous, inert substance that could be disposed of as nonindustrial solid waste. According to regulations, storage containers should remain closed [LHWR 21.8(d)(3) and 12.4(a)] and treatment to render a hazardous waste nonhazardous requires LDEQ authorization [LHWR 21.8(c)]. Also, none of the containers holding hardened epoxy or waste paints were marked as hazardous, and none had labels with accumulation start times, as required pursuant to LHWR 21.8(d)(1) and (2). In addition, neither storage area had an impervious base that could contain a spill, as required by LHWR 21.8(d)(3) and 12.6.

Furthermore, the site did not have a system to determine if wastes were hazardous, as required per LHWR 21.8(c) and 7.2. Therefore, hazardous wastes may have been shipped off-site without the site's knowledge and improperly disposed of, as confirmed by site personnel.

6.2.2 Toxic and Chemical Materials

6.2.2.1 General Description of Pollution Sources/Controls

6.2.2.1.1 Toxics Management

The control of toxic and chemical materials at West Hackberry is the combined responsibility of the Purchasing, Quality, Safety, and Environmental Departments. The Purchasing Department is responsible for circulating purchase requisitions to representatives of the Safety and Environmental departments. The Quality Department requests that the supplier provide a current Material Safety Data Sheet (MSDS) for all products used at West Hackberry. The Environmental Department can reject the purchase or use of a particular product at West Hackberry, due to potential occupational health or environmental concerns. An inventory of toxic and chemical materials at the site had been compiled at the time of the Environmental Survey.

Toxic and chemical materials are stored at several locations at West Hackberry (Figure 6-7). Warehouse D is used to store chlorofluoroalkanes and Warehouse E is a building for the storage of flammable materials. Warehouse E was recently constructed and has been provided with a concrete floor; however, containment dikes around the perimeter of the building were not included when the building was designed. Three other locations at West Hackberry are used to store toxic and chemical materials out-of-doors. These locations are the Maintenance Laydown Yard, an outdoor storage area adjacent to Warehouse E, and the Oily Wastes Storage/Holding Disposal Area. At each of these locations, 55-gallon drums and other containers of toxic and chemical materials are stored on drum racks or wooden pallets placed on the ground. At the time of the Environmental Survey, 20 drums of waste oils were stored on pallets in the Maintenance Laydown Yard. In the outdoor storage area adjacent to Warehouse E, 20 drums of various oils and 3 drums of mineral spirits were present. At the Oily Waste Storage/Holding Area, approximately ten containers of various sizes were being used to store oily wastes. These containers were open and subject to overflow from rainwater. All three of these outdoor storage areas are not protected from adverse weather conditions (i.e., lack a roof and walls) and impervious flooring and curbing to contain potential spills has not been provided. Therefore, in the event of a drum leak or rupture, spilled substances would contaminate surrounding soils and could be released into nearby surface waters. The storage of toxic and chemical materials at locations lacking effective spill control measures has previously been identified during environmental audits conducted by the operating contractor at other SPR sites (Teerling, 1987c), an EPA inspection of the Weeks Island site (Townsend, 1986), and a DOE-PMO Site

FIGURE 6-7

STORAGE AREAS FOR TOXIC AND CHEMICAL MATERIALS AT WEST HACKBERRY STRATEGIC PETROLEUM RESERVE

Management Appraisal at the St. James Marine Terminal (Wagoner, 1987). Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous waste) drum storage areas, such measures are considered good management/operational practice. A request to install covered drum storage racks at all SPR sites was submitted to DOE by BPS, but was not authorized (Teerling, 1987d). BPS is in the process of submitting similar requests to DOE to construct such facilities on a site-specific basis. West Hackberry relies upon the labels placed upon containers of toxic and chemical materials by the manufacturer to inform workers of the potential hazards associated with these materials, and regularly inspects these containers to determine if the manufacturers' labels are present. In addition, BPS has established formal procedures to comply with the requirements of the OSHA Hazard Communication Standard and similar requirements imposed by Texas and Louisiana (BPS, 1987b).

6.2.2.1.2 Tank Farm Facilities

Underground Storage Tanks

There are three USTs at West Hackberry, none of which are used to store wastes. For a complete discussion of the USTs at West Hackberry, see Section 6.2.1.2.4.

Above-Ground Storage Tanks

There are eight above-ground storage tanks at West Hackberry used to store toxic and chemical materials. These include

- A 294,000-gallon-capacity slop-oil tank. A dike (or secondary containment measure) capable of containing the contents of this tank in the event of a spill (i.e., overflow, tank rupture, etc.) has been constructed around the tank (BPS, 1986f).
- Two 500-gallon-capacity diesel tanks and one 250-gallon capacity gasoline tank at the fire water pump (all diked).
- A 1,500-gallon-capacity diesel tank at the fire training area (diked).
- Three 2,000-gallon (two gasoline and one diesel) tanks at the fuel station (diked).

6.2.2.1.3 Spill Prevention, Control, and Countermeasures (SPCC) Plan

The West Hackberry Site handles large volumes of crude oil and is located close to navigable waters. As a result, the requirements of the EPA Oil Pollution Prevention regulations (40 CFR 112) are particularly applicable to the site. In response to these requirements, West Hackberry has prepared and implemented an SPCC Plan (BPS, 1986f) and a Spill Contingency Plan (BPS, 1986e). These documents contain listings of potential spill sources, type and quantity of material that would be released, personnel and equipment resources, and spill evaluation, support and response procedures.

Engineering controls have also been implemented at the site. Containment dikes that drain to sumps equipped with oil/water separators have been constructed at each cavern wellpad. The high-pressure pump pad is equipped with a 6-inch curb to contain spills and this pad drains to an oil/water separator. The meter prover station also rests on a concrete pad. Spills from the pig trap area would drain to two sumps, the larger of which is equipped with a pump that automatically transfers any liquid in the sump to the slop-oil tank.

An Emergency Response Team (ERT) has been organized at West Hackberry. All ERT members receive 40 hours of training at the ERT Academy at Lamar University (Huff, 1988a). Some ERT members have also attended 40 additional hours of training on oil spill control and cleanup at Texas A&M University at Galveston. Spill control equipment is maintained at the site.

Formal monthly inspections of the site for deficiencies related to spill prevention and control are performed by the West Hackberry Environmental Specialist (BPS, 1986f). The inspection report is forwarded to the West Hackberry Site Manager for review.

SPR has established formal reporting requirements for oil spills of one or more barrels or oil spills of any quantity on navigable waterways. Similar reports must be prepared for brine spills of any quantity leaving the site or five or more barrels on-site. For spills of hazardous substances, the reporting requirements established by EPA have been implemented. During CY 1986, two reportable oil spills and two reportable brine spills occurred at West Hackberry (Teerling, 1987e). As described below, one oil spill resulted in the release of oil and brine off-site.

6.2.2.1.4 Cavern 111 Failure

On July 7, 1986, a wellhead component failure at Cavern 111 resulted in the release of about 7,500 barrels of crude oil, 1,000 to 2,000 barrels of brine, and nitrogen gas (DOE, 1986b). The release

took place over approximately a 14-hour period, with an initial 200-foot-high spray plume of oil escaping from the cavern. Prevailing winds carried about 50 percent of the released oil/brine outside the pad containment dike for approximately one-half mile into the surrounding marshlands and Black Lake. Oil clean-up operations required approximately one month; clean-up costs associated with the incident were \$1.7 million. The report that was prepared on this incident indicates that minimal environmental damage resulted from this release. For additional discussions of the Cavern 111 failure, see Sections 6.1.2.3.2 and 6.2.5.2.8.

6.2.2.1.5 Polychlorinated Biphenyls (PCBs)

It is the policy of SPR not to permit any equipment that is known to contain fluids with a PCB concentration in excess of 5 parts per million (ppm) on any SPR site (BPS, 1987a). There are currently three oil-filled transformers at West Hackberry, two at the raw-water-intake structure and one at the Interim Fill Field. The PCB concentrations in the transformers at the raw-water-intake structure are 3 ppm and <1 ppm (Robinson, 1985). The most recent analysis conducted on the oil in the transformer at the Interim Fill Field indicates that it contains 13 ppm PCBs (Van Franca, 1984). According to these results, the three transformers at West Hackberry are non-PCB transformers; however, the PCB content of the fluid in the transformer at the Interim Fill Field does exceed the SPR-established limit of 5 ppm PCBs. At the time of the Environmental Survey, the site had not scheduled to retrofit this transformer.

The oil in the transformers at the West Hackberry raw-water-intake structure previously contained higher concentrations of PCBs (188 and 27 ppm) (Robinson, 1985). In 1984, a contractor was retained to drain and refill these transformers. Thirty-two drums of PCB-contaminated oil and one drum of rags contaminated with PCBs were disposed at Ensco, Inc., El Dorado, Arkansas.

In August, 1985, a transformer stored for reuse in the Laydown Yard was knocked over, resulting in a 3- to 5-gallon spill of the transformer oil (Huff, 1985). The PCB content of this oil was 13 ppm (Phan, 1984). The spilled oil and affected soils were collected and disposed at PCB, Inc., Kansas City, Kansas (Huff, 1986).

No PCB-containing pole-mounted transformers, capacitors, or circuit breakers are known to be present at West Hackberry.

6.2.2.1.6 Pesticides

Pesticides (i.e., insecticides, herbicides and rodenticides) are used at West Hackberry and are applied both by site and contractor personnel. Restricted-use pesticides (i.e., pesticides that, according to EPA, must be applied only by a certified pesticide applicator or persons directly supervised by a certified pesticide applicator) are used only by contractor personnel who are licensed to handle such materials (Teerling, 1987f). The pesticides currently applied by contractor personnel include Demon 40 WP and Dursban (insecticides), Talon-G (rodenticide), and Roundup (herbicide).

West Hackberry personnel apply Roundup and Rodeo herbicides for weed control and Amdro insecticide for fire ant control. Cameron Parish performs all insecticide spraying for mosquito control. Written procedures governing the use of herbicides at West Hackberry have been established (Huff, 1987e), but application records are not maintained. Site personnel indicated that pesticides are applied in accordance with the directions on the pesticide container labels.

The supply of pesticides used at West Hackberry is stored in locked cabinets under the control of the Property, Operations, and Maintenance departments. These locations were inspected during the Environmental Survey and were found to be in an orderly condition, with no evidence of leaks or spills. Any rinsate waters generated from the mixing of pesticides prior to application are used in the sprayers to dilute the concentrated pesticides.

In addition to the herbicides that are applied by West Hackberry personnel at the site, a crew stationed in Sulphur Mines is responsible for spraying herbicides at road crossings and valve stations on the West Hackberry crude oil, brine discharge, and raw-water-intake lines. Herbicide 2,4-D is used for this purpose. Application records are not maintained.

A commercial aerial spraying contractor is also used to spray herbicides (Tordon K and Esteron 99) along the entire length of these pipelines. This contractor meets all the requirements for aerial herbicide spraying mandated by the Louisiana Department of Agriculture (Calhoun, 1986).

6.2.2.1.7 Asbestos

SPR operations began in the late 1970s. As a result, the various SPR sites, including West Hackberry, were constructed using relatively little asbestos-containing materials. However, asbestos-containing gaskets are in place on the SPR pipelines. SPR has established procedures for properly removing and disposing of these asbestos-containing gaskets during routine maintenance (BPS, 1986c). These

procedures will be utilized at West Hackberry until all asbestos-containing gaskets have been properly removed, disposed, and replaced with asbestos-free gaskets.

6.2.2.1.8 Chlorofluoroalkanes

Approximately 375 pounds of chlorofluoroalkanes are used at West Hackberry annually (Teerling, 1987h). These materials are used primarily as refrigerants in air conditioning units or to clean electrical parts. As a group, the chlorofluoroalkanes are relatively volatile compounds and potential environmental problems, due to vapor emissions, can result if they are not properly handled and stored. Of the chlorofluoroalkanes purchased by West Hackberry in 1987, approximately 80 percent was CFC-113 with the remainder CFC-12 and CFC-13. These materials are stored indoors at Warehouse D until needed. During the Environmental Survey, chlorofluoroalkanes appeared to be stored properly at West Hackberry.

6.2.2.2 Findings and Observations

6.2.2.2.1 Category I

None.

6.2.2.2.2 Category II

None.

6.2.2.2.3 Category III

1. Inadequate Secondary Containment Measures. There is a potential for releases of oil, chemical materials, and wastes into the environment from drum storage areas lacking effective spill containment. Drums containing chemical products and waste materials are currently stored out-of-doors, unprotected from adverse weather conditions at locations lacking impervious flooring and curbing to contain spills. In the event of a drum leak or rupture, spilled substances would contaminate surrounding soils and could possibly be released into nearby surface waters. This deficiency was previously identified during BPS environmental audits at other SPR sites, an EPA inspection of the Weeks Island site, and a DOE Site Management Appraisal at the St James Marine Terminal. Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous

waste) drum storage areas, such measures are considered good management/operational practice.

Deficient storage of chemical products and wastes noted by the Environmental Survey team at West Hackberry include

- About 30 drums of waste oils, ten of which were open and subject to overflow from rainwater, stored out-of-doors on pallets or directly on the gravel surfaces at the West Hackberry Maintenance Laydown yard and the Oily Wastes Storage/Holding area.
- Twenty drums of various oils and three drums of mineral spirits stored out-of-doors on drum racks or directly on the gravel surface in the storage area adjacent to Warehouse E.

6.2.2.2.4 Category IV

None.

6.2.3 Radiation

6.2.3.1 Background Information

The regulations applicable to the radioactive sources used at West Hackberry are summarized in Section 5.2.3.1.

6.2.3.2 General Description of Pollution Sources/Controls

There are 48 gamma-ray densitometers at the West Hackberry site. The activities of these units range between 100 mCi and 4,000 mCi of cesium-137. The sources are required to be leak-tested once every 3 years. The most recent leak test was performed in May 1987. No leaks were detected. The Survey team inspected the mounting of the units and found them to be secure.

A gamma-ray well-logging source was lost at Cavern 6 on June 30, 1978. The source contained 88 mCi of cobalt-60. A metal plaque containing the information required by the Louisiana Radiation Regulations is mounted at the surface to the well.

6.2.3.3 Findings and Observations

6.2.3.3.1 Category I

None.

6.2.3.3.2 Category II

None.

6.2.3.3.3 Category III

None.

6.2.3.3.4 Category IV

None.

6.2.4 Quality Assurance

6.2.4.1 General Description of Data Handling Procedures

The quality assurance aspects of the environmental monitoring program at the West Hackberry site are governed by the BPS Environmental Programs and Procedures Manual (Teerling, 1986c). The requirements of the manual are summarized in Section 3.2.4.1. The environmental monitoring program at the West Hackberry site includes the required NPDES discharge monitoring of the brine disposal line, the sewage treatment plant, and the storm water runoff from the cavern pads. In addition, West Hackberry conducts surface-water monitoring to assess the impact of site operations on adjacent surface-water bodies. The water monitoring at West Hackberry is discussed in more detail in Section 6.1.2.3.

The Environmental Survey team toured the West Hackberry laboratory and examined its quality assurance records. Laboratory practices and records were found to be consistent with the requirements of the BPS Environmental Programs and Procedures Manual (Teerling, 1986c).

The laboratory maintains bound logbooks for calibrations of instruments and sample analysis. The Survey team reviewed the logbooks and found them to be complete and up-to-date. All entries were in ink and corrections were made with a single line through the incorrect entry. All corrections were initialed. The procedures to be followed for each analysis were referenced in the appropriate logbooks.

A review of the 1987 internal quality control records indicated that laboratory precision and accuracy have been acceptable. More than 95 percent of the duplicate and spiked sample analyses satisfied the acceptance criteria, with the exception of "T-7 error." (See Section 3.2.4.1 for a discussion of "T-7 error.") The "T-7 error" criterion was violated for about 20 percent of the samples; however, the deviations were small and did not indicate any deficiencies that would compromise the validity of the data.

The Survey team reviewed the performance of West Hackberry in the 1987 laboratory intercomparison programs administered by BPS and EPA. During 1987, the laboratory's performance in the analysis of the BPS-submitted samples was within ± 1.5 standard deviations (based on the expected precision of the techniques) of the known values for all parameters. This is considered to be acceptable performance. For samples analyzed as a part of EPA's Discharge Monitoring Report Quality Assurance Program in 1987, performance was acceptable for all parameters except total suspended solids (TSS). The laboratory's TSS result was approximately 40 percent below the actual

result. The site Field Chemist explained that this was because the solid material used by the EPA is of low density and some was lost in the turbulence of the forced convection oven that was used for drying the sample (Verret, 1987). Since the solids actually found in West Hackberry are much heavier and therefore not lost as readily, this result does not necessarily indicate that the site monitoring data are inaccurate. The site has a gravity convection oven on order; this will minimize the likelihood of sample losses during drying.

The West Hackberry site does not have written sampling procedures. The Survey team observed sampling at two locations: the brine line and the high-pressure pump pad. No practices were observed that would compromise the quality of the data.

6.2.4.2 Findings and Observations

6.2.4.2.1 Category I

None.

6.2.4.2.2 Category II

None.

6.2.4.2.3 Category III

None.

6.2.4.2.4 Category IV

1. Lack of Written Procedures for Water Sampling. At the time of the on-site Survey, West Hackberry did not have complete written procedures for the field collection of water samples. The Environmental Survey team observed sampling at two sampling locations and did not note any practices that would be likely to compromise the validity of the data. Written procedures would provide documentation that proper sampling methodologies are being used in a consistent manner by all samplers and would help to support the validity of the data. In addition, the use of written procedures for training new or substitute samplers would help ensure that there would be no change in sampling methodology with a change in personnel.

6.2.5 Inactive Waste Sites and Releases

6.2.5.1 Background Information

The Survey team investigated each of the SPR facilities to identify inactive waste sites and releases of hazardous materials that are sources or potential sources of environmental contamination. Inactive sites and hazardous materials releases reviewed by the Environmental Survey team may either be subject to various environmental regulations or may not be addressed by the environmental regulatory framework. The Survey team identified and inventoried all inactive sites and hazardous materials releases that may cause environmental problems, regardless of the regulatory status of the sites or materials involved. Document reviews, personal interviews, and brief site visits are the basis for the observations and findings described in this section.

Many of the inactive waste sites and releases identified by the Survey team may be subject, via the Federal facilities provision, to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and associated Executive Orders. Therefore, DOE Order 5480.14 (under revision) was issued on April 26, 1985 to implement DOE's CERCLA Program, which is intended to define actions to identify and evaluate inactive hazardous waste sites on DOE installations, and to effect remedial actions, where warranted. The first two phases of a five-phased program, prescribed under DOE Order 5480.14, were completed before the Survey team visited the SPR sites. A report was prepared under each of these two phases, the Phase I CERCLA Report: Installation Assessment, April 1986 (BPS, 1986b), and the Phase II CERCLA Report: Confirmation, April 1987 (BPS, 1987f). According to DOE 5480.14, Phase I was intended to "evaluate site history and records, and to locate and identify those inactive hazardous waste disposal sites that may pose a risk to health, safety and the environment as a result of migration of hazardous substances." Phase II was described by DOE 5480.14 as an effort to "quantify, by preliminary and comprehensive environmental survey, the presence or absence of hazardous substances that may pose a risk to health, safety, and the environment." The Survey team used the Phase I and II CERCLA Reports to aid in identifying and evaluating inactive waste sites and releases.

Since passage of the Superfund Amendments and Reauthorization Act (SARA) of 1986, DOE has revised its CERCLA program and DOE Order 5480.14 to implement the new SARA requirements. DOE has replaced the five-phased program and adopted the Environmental Protection Agency (EPA) program as outlined in the National Contingency Plan. DOE also issued guidance to its facilities on how to use data collected under its old CERCLA program to meet requirements of SARA. Conversion of Phase I CERCLA reports (i.e., Installation Assessments) to Preliminary Assessments (i.e., the first step under the EPA program) was to be completed by April 1988.

This section provides an overview of uncontrolled releases of hazardous substances into the environment from inactive waste sites and spills at West Hackberry. Information was obtained from SPR personnel and files, employees of former site tenants, and the Phase I CERCLA Report.

6.2.5.2 General Description of Pollution Sources/Controls

There are no significant sources of contamination at West Hackberry from inactive waste disposal sites and past spills of hazardous substances. Prior industrial activity on the DOE property was minimal and only nonhazardous drilling muds have been disposed of on-site during SPR activity. EPA Region VI inspected the site during June 1985 and noted that hazardous wastes were not produced or disposed of on-site and that the site exhibited excellent industrial housekeeping (BPS, 1986b). SPR's Phase I CERCLA Report also noted no existing or potential sources of environmental contamination (BPS, 1986b). No further action at West Hackberry was recommended after the Phase I installation assessment and, thus, West Hackberry was not included in Phase II investigations. However, major oil and brine spills have occurred on-site. Prior industrial activity, drilling mud and cuttings disposal as well as oil and brine spills are discussed below.

6.2.5.2.1 Prior Industrial Activity

Prior to DOE acquisition of the property, pasture was the primary land use at West Hackberry (BPS, 1986b). Exploration for oil at West Hackberry began in 1902, but no oil was discovered until 1928. There are currently many oil-producing wells on the perimeter of the dome, but none on DOE property. Exploration for sulfur, including an exploratory Frasch well located between Caverns 8 and 9, was undertaken, but no sulfur mining occurred. The only known industrial activity to take place on DOE property was that of the Olin Corporation, starting in 1934. Olin produced brine for transport off-site. Five of the caverns from Olin's brining operations were acquired for SPR crude-oil storage caverns.

6.2.5.2.2 Central On-Site Drilling Mud Pit

A single large mud pit was used initially for the drilling of some cavern wells (i.e., those in the second phase of cavern development). According to site personnel, this pit was located south of Wellpad 115 and was used during 1980. It served as part of an experiment to centralize drilling mud mixture and recycling. However, centralized mud mixture and recycling was abandoned, because it proved to be unworkable. Frac tanks were then used to mix and recycle drilling muds. Muds in the pit were removed and the pit was then backfilled. Muds were recycled or disposed of off-site by the

drilling contractor at an approved commercial oilfield waste disposal facility (i.e., the Campbell Wells facility in Mermentau, Louisiana).

6.2.5.2.3 Disposal of Drilling Muds and Cuttings

According to site personnel, returned drilling muds and cuttings generated from the construction of cavern wells and brine disposal wells, during 1978 and 1979, were disposed of on-site in reserve pits located adjacent to the wellpads. These pits were subsequently cleaned out and the resulting materials were disposed of at the Campbell Wells facility. Returned muds and cuttings generated subsequent to that period were disposed of off-site at approved commercial disposal facilities. According to file records on all cavern wells and brine disposal wells, only the drilling of Well 117B involved the use of a hazardous mud additive (i.e., chrome lignosulfonate). Frac tanks were used to store the return muds from this well. The muds were disposed of off-site.

6.2.5.2.4 Oil and Brine Spills

Several major and minor oil and brine spills have occurred at West Hackberry during SPR activity. Sources of spills have included the crude oil storage system, on-site oil handling, on-site brine handling, and off-site pipelines for oil and brine. There was also a 1-barrel spill of 9.6 percent hydrochloric acid. Some of these spills caused minor environmental damage, but significant impacts were mitigated by quick response, including spill containment, oil and brine recovery, and removal of contaminated soils and materials. There is no indication that any of the spills at West Hackberry have resulted in permanent or major environmental damage. At the time of the Survey, there were only minor environmental traces of oil and brine spills. These included stressed vegetation and remnants of materials used during response. Five major spills are described below.

On July 7, 1986, a major release of oil and brine occurred at the West Hackberry Cavern 111 wellhead (DOE, 1986b). During an integrity test of the cavern, using nitrogen gas under pressure, a wellhead component failure resulted in the release of approximately 7,500 barrels of crude oil, 1,000 to 2,000 barrels of brine, and nitrogen gas. The high pressure forced a spray of these released materials approximately 200 feet high. Wind carried approximately half of the oil/brine mixture beyond the wellpad containment dike and dispersed a mist of the mixture up to 0.5 mile from the pad. Adjacent properties, marshlands, and Black Lake were affected. Emergency response measures involved deployment of containment booms, use of fire fighting foam, and frac tanks to temporarily store recovered oil. About 6,525 gallons of fire fighting foam were used to blanket oil within the containment dikes to reduce flammable vapors. Clean-up operations lasted approximately 35 days and resulted in the recovery of approximately 6,132 barrels of oil (81.8 percent of that spilled).

Surrounding areas and structures affected by the release were cleaned. The recovered oil was returned to storage through the slop-oil system or frac tanks.

Environmental damage as a result of this spill was minor (DOE, 1986b). A number of fish and aquatic insects were killed by the incident in the immediate area; most as a result of oxygen depletion caused by the fire fighting foam. However, no residual foam was found in water samples collected after the incident from the area surrounding the oil containment booms. Monitoring data (e.g., pH, salinity, dissolved oxygen, and oil and grease levels) obtained after the incident also revealed that the quality of the lake and its surrounding waters was minimally affected. No other dead wildlife was observed during the incident.

A major brine spill and several other major oil spills occurred at the West Hackberry facility prior to the July 1986 spill. On December 8, 1985, a failure in the 36-inch brine line at West Cove (Calcasieu Lake) near ship channel mile markers 8 and 9, released between 370,000 and 575,000 barrels of brine into the Gulf. A field investigation was conducted and no environmental impact from the release was identified (DOE, 1986c). On January 4, 1984, failure of a pipe nipple during transfer of crude oil from Cavern 108 to Caverns 103 and 110 resulted in the spill of approximately 350 barrels of crude oil (DOE, 1984). On April 25, 1981, failure of a pipe nipple during transfer of crude oil from Cavern 6 to Cavern 9 resulted in the spill of approximately 1,000 to 1,400 barrels of crude oil (DOE, 1981). On September 21, 1978, due to a wellhead failure and inadequate safety procedures at that time, a spill of approximately 67,510 barrels of crude oil resulted in an explosion, fire, one injury, and one fatality (DOE, 1978c). These oil spills were cleaned up and no permanent environmental damage resulted.

6.2.5.3 Findings and Observations

6.2.5.3.1 Category I

None.

6.2.5.3.2 Category II

None.

6.2.5.3.3 Category III

None.

6.2.5.3.4 Category IV

None.

PRELIMINARY

7.0 WEEKS ISLAND

The Weeks Island site is located in Iberia Parish, Louisiana, about 12 miles south of New Iberia and about 95 miles west of New Orleans (Figure 7-1). The Department of Energy (DOE) acquired this storage site in 1977 and converted the existing conventional salt mine, with a capacity of 73 million barrels, to oil storage. Development and fill of this site was completed in 1982. The Weeks Island site is currently in an operational standby mode (DOE, 1987).

The Weeks Island salt dome borders Vermilion Bay, which opens to the Gulf of Mexico. The surface expression over the salt dome, caused by domal upthrusting, forms the "Island" and includes the highest elevation (171 feet) in southern Louisiana. The salt dome is roughly circular with a diameter of 2 miles. It is mostly covered with a second growth deciduous forest. Parts of the island have been cleared for sugar cane, but farming is limited to a few hundred acres on the eastern portion of the dome. A room-and-pillar salt mine is located under the island adjacent to the SPR site. Oil and gas production facilities are located at the edge of the island. The island itself is virtually uninhabited and the surrounding area is sparsely populated.

The coastal wetlands at the Weeks Island site include the manmade Intracoastal Waterway, saline and brackish marshes, and bayous. These water bodies provide a vast estuarine nursery ground for an array of commercially and recreationally important finfish and shellfish.

The salt mine forming the storage systems at Weeks Island is a network of large horizontal tunnels (drifts) on two levels, mined at right angles to each other in a room-and-pillar configuration. The upper level is at a depth of 535 feet below sea level and the lower level is at 735 feet. (The salt dome itself is thought to continue to a depth of 16,000 feet.) Vertical shafts and boreholes connect upper and lower mine levels. These include the production shaft and the service shaft. The production shaft was originally used for salt removal. It is now used for access for workers and equipment to the area above the oil storage levels and is sealed off from the storage area by a bulkhead. The service shaft is the original mine access shaft constructed in 1902 (and still in good condition). A section of this shaft above the oil storage area was enlarged to form a manifold room. This room holds pump and pipe handling equipment and sits atop a bulkhead, which supports the 11 submersible pumps used for withdrawing oil from the mine. These booster pumps withdraw oil from a sump at the base of the service shaft.

The mine is vented from the upper level through a vent hole to the surface. The mine is filled with oil through two fill holes into a sump beneath the floor of the lower level. These vent and fill holes lead directly from the surface to the oil storage area.

FIGURE 7-1

WEEKS ISLAND, LOUISIANA, SITE LOCATION STRATEGIC PETROLEUM RESERVE

When DOE acquired the existing mine from Morton Salt, it was agreed that Morton could continue mining by using the existing mine shafts, utilities, hoists, and ventilation for development of an interim mine. This interim mine is known as the Markel Mine and is northwest of the oil storage area at approximately the same depth as the upper storage level. An inclined drift known as the Markel Incline led from the lower mine level (now used for oil storage) to the interim mine. This drift is now blocked by another bulkhead. The interim mine is now unused. Morton has two new shafts leading to a new mine at approximately the 1,200-foot level beneath the Markel Mine.

7.1 Media-Specific Survey Findings

The discussions in this section pertain to existing or potential environmental problems in the air, surface water, and groundwater/soil media. The discussions include a summary of the available background environmental information related to each medium, a description of the sources of pollution and their control techniques, a review of the environmental monitoring program specific to each medium, and a categorization and explanation of the environmental problems found by the Survey team related to each medium.

7.1.1 Air

7.1.1.1 Background Environmental Information

The air portion of the Environmental Survey of the Weeks Island site is designed to address existing and potential environmental impacts associated with releases of contaminants to the atmosphere and includes a critical evaluation of air pollution sources and controls as well as compliance with air pollution regulations. Adherence to established environmental procedures is evaluated from the standpoint of environmental problems or risks. Principal regulations relating to air emissions used as guidance during the Survey include

- The Clean Air Act (CAA) and Amendments
- Federal Regulations, including
 - National Ambient Air Quality Standards (NAAQS) (40 CFR 50)
 - Standards of Performance for New Stationary Sources (40 CFR 60)
- Louisiana Air Quality Regulations

The Weeks Island salt dome is located in Iberia Parish, Louisiana, which is included in the Southern Louisiana-Southeast Texas Interstate Air Quality Control Region (AQCR) No. 106 (40 CFR 81.53, July 1, 1987).

The national ambient air quality standards (see Table 3-1) have been incorporated into Louisiana air pollution control regulations and are enforced throughout the state. The attainment status of AQCR No. 106 is described (40 CFR 81.319, July 1, 1987) as follows:

Parameter	Status
Total Suspended Particulates	Better than National Standards
Sulfur Dioxide	Better than National Standards
Ozone	Cannot be Classified or Better than National Standards
Carbon Monoxide	Cannot be Classified or Better than National Standards
Nitrogen Dioxide	Cannot be Classified or Better than National Standards

The status of other criteria pollutants, including PM-10, particulate matter and lead, has not been published.

Wind data recorded at Lake Charles Airport, which is about 85 miles west northwest of Weeks Island, are representative of air-flow patterns along that section of the Gulf Coast. Characteristic wind patterns for stations near the SPR sites are discussed in Section 2.1.

7.1.1.2 General Description of Pollution Sources/Controls

A Certificate of Approval for Air Emissions at the Weeks Island SPR (Permit No. 1105) was issued by the Louisiana Air Control Commission on January 30, 1979 (LACC, 1979). The Permit addressed volatile organic compound (VOC) emissions that would occur during withdrawal, unloading, and refill operations as follows:

Operation	Estimated VOC Emissions From All Sources (tons per year)
1979 Unloading	1
1980 Unloading	1
150-Day Withdrawal	8
Subsequent Refill	40

However, the specific locations at which these emissions were expected to occur were not described. The Permit discusses the salt-mine storage of 75 million barrels of crude oil, a smokeless flare, two tanks (sizes and uses not given), an inert-gas system, auxiliary equipment, and miscellaneous VOC sources, but does not apportion a stated VOC emission limit of 1.6 pounds per hour across the individual units. Potential sources of emissions to the atmosphere that were not addressed in the Permit include (1) Vapor-recovery Unit, (2) Stationary Diesel Engines, and (3) Unpaved-Road Dust Emissions. The locations of these sources are shown in Figure 7-2.

Because the Weeks Island facility was originally formed by mechanical mining techniques rather than by cavern leaching, it has features that are unique within the SPR. Because no cavern leaching is/was performed, there are no surface facilities to handle or dispose of brine solution and, therefore, no potential for emissions of VOCs from the brine. On the other hand, because the salt mine contained air, it was necessary to displace the air with an inert gas. The inert gas was required so that VOCs from the crude oil being injected could not form an explosive mixture with air in the mine cavity.

7.1.1.2.1 Inert-Gas Generator

An "inert" gas was initially produced on-site by burning diesel fuel in two inert-gas generators. The generators were subsequently converted to burn propane gas. The combustion products (which contain generally less than 6 percent oxygen) were injected into the mine cavities, displacing air that has a normal oxygen content of about 22 percent. Now that the mine cavities are filled with crude oil, the inert-gas generators are fired only infrequently for preventive maintenance or test purposes. During these tests, the combustion products, which consist largely of nitrogen, carbon dioxide, water vapor, and uncombined oxygen, are vented to the atmosphere.

Propane gas, to fuel the inert-gas generators, is produced on-site by heating liquid propane in a propane-fired vaporizer. Combustion products from the clean-burning propane are exhausted to the atmosphere.

The Permit does not specify emission limits or estimated rates for either the inert-gas generator or the propane vaporizer.

Source: Adapted by DOE Environmental Survey Team from BPS, 1987h.

FIGURE 7-2

LOCATION OF AIR-EMISSION SOURCES AT WEEKS ISLAND STRATEGIC PETROLEUM RESERVE

7.1.1.2.2 Vapor Recovery Unit and Smokeless Flare

During fill operations, the inerted cavern atmosphere (saturated with VOCs from the crude oil being injected) was displaced through a vent line to the flare stack. The vapor-recovery unit was never used because the displaced inert atmosphere was not rich enough to operate its unit; instead, the displaced cavern atmosphere was passed through a smokeless flare where the VOCs were burned with the support of propane gas. Because the crude oil contained sulfur compounds, some hydrogen sulfide was expected to be present in the cavern atmosphere during fill operations and conversion of the hydrogen sulfide to sulfur dioxide in the flare was reflected in the Permit. A data sheet attached to the Permit limits sulfur dioxide emissions to not more than 1,091 pounds per hour. Monitoring of the vent gas throughout fill operations demonstrated that H₂S was not detectable (less than 1 ppm).

7.1.1.2.3 Miscellaneous VOC Sources

The Permit provides a miscellaneous category of VOC sources. An attached data sheet limits VOC emissions to 1.6 pounds per hour from this category of sources. No detail is given on how the emissions would be apportioned over the unnamed individual sources, nor are any controls or monitoring specified.

7.1.1.2.4 Stationary Diesel Engines

Two stationary diesel engines are on-site at Weeks Island. One engine powers an emergency generator that supplies electricity to operate computers and for orderly shutdown in the event of a commercial power failure. The second engine powers a pump to provide backup pressurization of the fire-water system. Neither engine is mentioned in the Permit nor do regulations require that they be included.

7.1.1.2.5 Unpaved-Road Dust Emissions

Fugitive dust emissions generated by vehicular traffic on Snyder Lane (the main entrance road) were alleviated by paving the 2-mile road. Other roads around the site are owned by Morton Salt.

7.1.1.2.6 Space Heating

Space heating at Weeks Island is provided by electricity.

7.1.1.3 Environmental Monitoring

7.1.1.3.1 Monitoring of Ambient Air Quality

A monitoring program was initiated by a DOE contractor at Weeks Island on October 1, 1982 to determine baseline ambient-air quality. The program continued through December 31, 1983 (York, 1984). Parameters monitored during that period were total suspended particulates, ozone, nonmethane hydrocarbons (i.e., volatile organic compounds), free chlorine, and hydrogen chloride. The total suspended particulates exceeded both primary and secondary annual and 24-hour standards, while ozone exceeded the hourly standard (which is not uncommon in an AQCR designated as a nonattainment area for ozone). Although there are no current air-quality standards for nonmethane hydrocarbons, the maximum hourly value was 1.09 ppm (York, 1984). There are no regulatory requirements for continued air-quality monitoring.

7.1.1.3.2 Emission Monitoring

As required by the Louisiana Environmental Control Commission (Regulation 17.12), a report of calculated emissions and a revised Emissions Inventory Questionnaire (EIQ) were prepared for Weeks Island following submittal of a Completion of Construction Certification in July 1983 (Madson, 1984). The calculated emissions are summarized in Table 7-1. The revised EIQ provides detailed estimates of emissions for the Weeks Island facility. The Permit did not require SPR to perform any sampling or monitoring of these VOC emission sources. However, in response to Permit requirements, measurements of hydrogen sulfide concentrations in gases vented to the flare were made and sulfur dioxide emissions were calculated (Leemann, 1981a). The results of those measurements and calculations showed that sulfur dioxide emissions were less than 1.3 pounds per hour. The Permit limit was 1,091 pounds per hour.

7.1.1.4 Findings and Observations

7.1.1.4.1 Category I

None.

7.1.1.4.2 Category II

None.

TABLE 7-1

**EMISSION RATES AND EMISSIONS CALCULATED FROM ACTUAL OPERATIONAL CONDITIONS
WEEKS ISLAND SITE
STRATEGIC PETROLEUM RESERVE**

		FLARE STACK				MISCELLANEOUS VOC SOURCES					
		SULFUR DIOXIDE		FLOW		VALVES		PUMP SEALS		TOTAL	
		Pound per Hour	Pounds	Cubic Feet per Minute	Cubic Feet (x10 ³)	Pound per Hour	Pounds	Pound per Hour	Pounds	Pound per Hour	Pounds
CALCULATED EMISSIONS	1980	0.0080	4.3531	3,794.02	101.222	0.0326	18.5242	0.0942	2.2600	0.0366	20.7842
	1981	0.0175	53.3835	6,782.22	1,241.309	0.0316	96.4971	0.0942	0.6592	0.0318	97.1563
	1982	0.0096	15.0245	3,712.00	349.358	0.0346	57.3804	0.0942	8.5692	0.0397	65.9496
	1983(1)	0.0100	0.7525	3,883.52	17.499	0.0325	2.5411	0.0942	0.2825	0.0362	2.8236
	COMPOSITE	0.0140	73.5136	5,439.48	1,709.389	0.0326	174.9428	0.0942	11.7709	0.0348	186.7137

Source: Madson, 1984.

(1) January 1 through June 30, 1983.

7.1.1.4.3 Category III

None.

7.1.1.4.4 Category IV

None.

PRELIMINARY

7.1.2 Surface Water

7.1.2.1 Background Environmental Information

7.1.2.1.1 Surface-Water Bodies in the Area

As can be seen in Figure 7-3, the Weeks Island Site is surrounded on the north and east by Weeks and Warehouse Bayous, on the south by a dredged channel to the Weeks Island Oil and Gas Field in the marsh, and on the west by the Intracoastal Waterway (ICW). These adjacent waters are brackish. This figure also shows the location of the six freshwater ponds on the island. Plantation Lake, with an area of approximately 20 acres, is the largest of these ponds. Their maximum depths are estimated to be only 10 feet. Only Sandy Bottom Pond receives any waters from DOE property on Weeks Island. It receives both storm-water runoff and sanitary-sewage-treatment-plant effluent from the laydown and warehouse area of the site. None of these ponds discharge water onto the DOE site.

7.1.2.1.2 Sources of Water Used at the Site

All water used at the site, except for drinking water, comes from Water Well No. 3, which is located in the Laydown Area. Water Well No. 2, located in the Fill Area, can be used in an emergency. However, a temporary connection from the well to a fire hydrant must be installed in order to make this water available to the site. Bottled water is supplied for drinking (Chatelain and Roberts, 1987).

7.1.2.1.3 Flood Plain

All DOE property on Weeks Island is above the 25-foot contour line and thus is above the 100-year flood plain. No past flooding has occurred at the DOE areas on Weeks Island.

7.1.2.2 General Description of Pollution Sources/Controls

7.1.2.2.1 Water Uses at Site

Bottled water is supplied for drinking purposes because the site's wells have not been permitted by the state for potable use. The necessary documentation (such as well driller certification etc.) is not available for getting permits for Wells 1 and 2. Well No. 1 has been plugged and abandoned. Well No. 2 is not connected to the system, although a temporary connection could quickly be made in an emergency. The site has been careful to comply with the regulations and to maintain proper records

FIGURE 7-3

SURFACE WATERS IN THE VICINITY OF WEEKS ISLAND STRATEGIC PETROLEUM RESERVE

while installing Well No. 3. They are in contact with the state regarding the steps (i.e., disinfection, etc.) to be taken in order to get the entire supply and distribution system from Well No. 3 approved for potable use.

A water treatment plant to remove iron and manganese has been installed across the road from Well No. 3. It had not been put into service at the time of the on-site Survey. The treatment plant essentially consists of a means of feeding potassium permanganate, chlorine, and sodium carbonate to the well water ahead of a mixed bed filter of anthracite and glauconitic green sand. The potassium permanganate readily oxidizes the iron and manganese present in the well water, so that it precipitates out of solution and is removed by the filter media. The sodium carbonate is fed to keep the pH near 7.0 for best results. The chlorine is fed for disinfection as well as to reduce the amount of potassium permanganate required. (Chlorine also oxidizes iron and manganese, but at a slower rate than potassium permanganate.) The green sand has the ability to take up excess permanganate when it is present and then allow it to be used later, to oxidize iron or manganese, if there is insufficient permanganate being fed with the influent stream. The precipitated material that collects in the filter is periodically backwashed into a settling basin. The bottom of the settling basin contains six layers of gravel, graded from 1/16 inch to 1-1/2 inches, which will act as a filter to remove the precipitates from the backwash water before it is discharged to the ditch along the road. This filtered backwash discharge has been designated as Outfall 003 in the NPDES permit.

The well water supplies a 500,000-gallon storage tank in the Fire Water Area northeast of the Main Site Area. This tank feeds both the Fire Water System and the utility water system. The non-potable utility water is used for wash-down hose connections, cooling tower make-up, and to supply the water to sinks and toilets.

The fire protection system at Weeks Island, as is done at other SPR sites, uses Aqueous Film Forming Foam (AFFF) in order to improve the fire extinguishing capabilities of the system. This material is effective in covering and extinguishing hydrocarbon liquid-based fires. AFFF is obtained from a variety of suppliers through competitive bids. However, all the materials have similar characteristics of high biochemical and chemical oxygen demand (BOD and COD); are mostly biodegradable; contain 5 percent or less fluorocarbon surfactants, which are not biodegradable; and exhibit varying degrees of aquatic toxicity, although they are classified as practically nontoxic in the manufacturer's literature. This is because the oral LD₅₀ for rats is greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the species to which it is administered.) The oxygen depletion due to the high BOD and COD, coupled with the aquatic toxicity, could result in short-term environmental degradation if this material is released to adjacent surface water. The as-purchased concentrate is mixed with water to provide a 3 percent solution to be sprayed on the fire. The foam

deluge systems in the pump building and the electrical substation have automatic foam proportioning systems to provide the required mixture. The mobile fire fighting equipment is also capable of using AFFF. SPR procedures call for annual testing of the fire protection systems and training of personnel. SPR has estimated that 15,933 gallons of 3 percent AFFF solution would be generated annually in training and testing exercises at Weeks Island. Because the AFFF is mostly biodegradable, the sewage treatment plant could treat the waste; however, the annual capacity of the existing systems for treating AFFF is only 2,173 gallons. In addition, there is no collection system in place at Weeks Island. SPR has temporarily suspended testing and training requirements until the disposal problem has been resolved. At the time of the on-site portion of the Survey, SPR was continuing dialog with the state and investigating disposal options. Subsequent to the on-site portion of the Survey, the Louisiana Department of Natural Resources granted permission for the disposal of AFFF into SPR's saltwater disposal wells (Welsh, 1988). A finding relating to a problem with disposal of this material is presented in Section 7.1.2.4.3.

7.1.2.2.2 Sanitary Sewage

There are two packaged extended aeration, activated sludge, sewage treatment plants at Weeks Island. The one serving the Main Site Area has a rated capacity of 2,000 gpd and receives 1,600 gpd flow, while the other serving the Warehouse and Laydown Area has a capacity of 5,145 gpd but only receives 200 gpd. Their effluents are NPDES Outfalls 01B (into the drainage ditch south of the Main Site Area) and 002 (into the drainage area north of the Laydown Area that flows to Sandy Bottom Pond), respectively. Operational problems, as at other sites, are due primarily to underloading of the plant and occasional destruction of the bacteria by cleaning compounds entering the system. Administrative controls have been instituted to solve the cleaning chemical problem and dog food is periodically fed into the system as a supplemental supply of organic nutrients for the bacteria.

7.1.2.2.3 Storm Water

Storm water and drainage from locations (such as the meter prover pad, pig launching/receiving pad, mainline pump building, and shop floor drains) that are likely to become contaminated with oil at the Main Site Area are connected to an API oil/water separator that is used to remove oil from the water. The discharge from the API oil/water separator, as well as other storm waters from the Main Site Area, go to an inspection pond prior to being discharged to the drainage ditch south of the Main Site Area through NPDES Outfall 01A. If oil is observed on the surface of the inspection pond, sorbent pads are used to remove it from the surface of the water. A mechanical oil skimmer is stored in an enclosure adjacent to the pond for use, if there is a large volume of oil to collect. However, it is not always as effective as absorbent pads for removing trace amounts of oil.

7.1.2.2.4 Brine Disposal

Because Weeks Island does not store oil in solution mined caverns as is done at other sites, there is no brine to dispose of from leaching or filling operations. Brine does collect under the surface of the oil because of water introduced with the oil, water vapor condensed from the atmosphere of inert gas between the oil and the roof of the mine, and the hydrostatic testing of the pipeline from the St. James Terminal to Weeks Island. This brine is pumped to the surface and disposed of off-site as a nonhazardous oilfield waste. See Sections 7.1.3.2.2 and 7.2.1.2.1 for discussions on brine in the mine at Weeks Island.

7.1.2.3 Environmental Monitoring Program

7.1.2.3.1 NPDES Monitoring

Discharges from Weeks Island are covered by NPDES Permit LA0056243 which was issued by the EPA on October 14, 1982 and expired on October 13, 1987, and by Water Discharge Permit No. 1051 issued by the State of Louisiana Department of Environmental Quality on January 17, 1987, which is effective for 5 years from issuance. The site has submitted (and has in its files, a letter from the EPA dated October 15, 1987, acknowledging the receipt of) the NPDES permit renewal application.

The locations of the permitted outfalls are shown in Figure 7-4. The monitored parameters, their limits, and monitoring requirements for each of the outfalls are listed in Table 7-2. The only exceedances of these limits during 1986 were four for BOD at the sewage treatment plant discharges that exceeded the daily maximum limit of 45 mg/L. Two at Outfall 001B (77 and 98 mg/L) and one at Outfall 002 (56 mg/L) were due to unknown causes. However, it is suspected that the disposal of floor wax into drains resulted in the sewage treatment plant upsets. One at Outfall 002 (48 mg/L) was due to a malfunction in a timer used to control aeration in the sewage treatment plant. This resulted in rapid consumption of the organic material by the microorganisms and the eventual depletion of their nutrient supply.

7.1.2.3.2 Water System Monitoring

Although the water system is not approved for potable use, the state takes quarterly samples for bacteriological analysis. Records for these samples for the past 5 years were reviewed and all results

FIGURE 7-4

NPDES MONITORING LOCATIONS AT WEEKS ISLAND
STRATEGIC PETROLEUM RESERVE

TABLE 7-2

DISCHARGE MONITORING REQUIREMENTS AND EFFLUENT LIMITATIONS
WEEKS ISLAND SITE
STRATEGIC PETROLEUM RESERVE

Outfall	Parameter	Minimum	Daily Average	Daily Maximum	Measurement Frequency	Sample Type
01A Storm-Water Runoff	Flow	N/A	Report	Report	1/month	Instantaneous
	O&G	N/A	N/A	15 mg/L	1/month ⁽¹⁾	Grab
	pH	6.0 S.U.	N/A	9.0 S.U.	1/month ⁽¹⁾	Grab
01B & 002 Sanitary Sewage Discharge	Flow	N/A	Report	Report	1/month	Instantaneous
	BOD	N/A	30 mg/L	45 mg/L	1/month ⁽²⁾	Grab
	TSS	N/A	30 mg/L	45 mg/L	1/month ⁽²⁾	Grab
	Fecal C.	N/A	200/100 ml	400/100 ml	1/month	Grab
	pH	6.0 S.U.	N/A	9.0 S.U.	1/month	Grab
003 Filter Backwash Water ⁽³⁾	Flow	N/A	Report	Report	1/month	Estimate
	TSS	N/A	Report	45 mg/L	1/month	Grab
	pH	6.0 S.U.	N/A	9.0 S.U.	1/month	Grab

Source NPDES Permit LA0056243

- (1) State permit requires increase to 1/week of the daily maximum or range is exceeded.
 (2) State permit designates a 1/quarter frequency unless the daily maximum is exceeded, in which case a 1/month frequency is required.
 (3) A requirement of the state permit only. Renewal submitted September 1987 includes this outfall.

were satisfactory. The site also ran analyses for the primary and secondary drinking water standard parameters in 1984 and 1986. Only iron and manganese exceed the standards of 0.3 and 0.05 mg/L, respectively.

7.1.2.3.3 Surface-Water Monitoring

Weeks Island does not monitor off-site surface waters because the site's impact on them could not be distinguished from the impact of adjacent non-DOE facilities. There is no regulatory requirement for surface-water monitoring.

7.1.2.4 Findings and Observations

7.1.2.4.1 Category I

None.

7.1.2.4.2 Category II

None.

7.1.2.4.3 Category III

1. Potential Oxygen Depletion of Nearby Surface Water From the Discharge of Aqueous Film Forming Foam (AFFF). AFFF is used throughout the SPR, because it is effective in covering and thus extinguishing hydrocarbon liquid-based fires. The release of untreated AFFF into surface waters can have an adverse impact on surrounding wetlands. Although the materials available at the SPR sites will vary slightly in composition, they are characteristically classified by the manufacturers as being biodegradable and practically nontoxic, having an LD₅₀ of greater than 5 g/kg. (LD₅₀ is that dose of material that will result in the death of 50 percent of the test specimens to which it is administered.) These materials also contain fluorocarbon surfactants (5 percent or less) that are not biodegradable. AFFF materials exhibit varying degrees of aquatic toxicity and have a high biochemical oxygen demand (BOD) and chemical oxygen demand (COD). Therefore, AFFF, if discharged to adjacent surface water, could result in temporary oxygen depletion in those waters, in addition to being toxic to some aquatic species. Although there is no restriction on its use in emergency situations, state regulatory agencies require that it be treated prior to discharge when used in training or performance tests. This creates a disposal problem. Under optimum conditions, sewage treatment plants of

the types installed at the SPR sites can effectively treat waste AFFF material; however, 15,933 gallons of waste AFFF are expected to be generated annually during training exercises and performance tests at Weeks Island. The treatment plant could handle only an estimated 1,173 gallons per year. Subsequent to the on-site portion of the Survey, permission was received from the state to dispose of AFFF into SPR's saltwater disposal wells (Welsh, 1988). The installation of containment is being done under Project No. WI-M-071, with completion expected early in 1989. The use of AFFF for training and performance testing purposes has been temporarily curtailed until the waste disposal issue is adequately addressed.

7.1.2.4.4 Category IV

None.

7.1.3 Groundwater/Soil

7.1.3.1 Background Environmental Information

Weeks Island is one of the Five Island salt domes aligned in a northwest-southeast direction in southern Louisiana. The "islands" are so named because they form topographic highs in the surrounding bayous. The other four are Jefferson, Avery, Cote Blanche, and Belle Isle. All have been mined for salt.

There is no caprock over the Weeks Island salt dome. The unconsolidated sedimentary deposits between the top of the salt and the land surface are a series of Pleistocene to recent sands and gravels with discontinuous lenses of clays and silts. The water-bearing sands above the salt represent the shallow sand unit of the Chicot aquifer system. The water table in the Chicot aquifer is approximately at sea level in the Weeks Island area and slopes slightly to the northwest on a regional basis, due to heavy groundwater pumping near Lake Charles. Thus, the natural southward groundwater flow to the Gulf is modified by induced flow to the northwest.

Shallow perched groundwater apparently exists above the regional water table at Weeks Island. Levels of rain-fed, fresh water ponds on the island may vary from 15 to 60 feet above sea level. These ponds are probably controlled by the presence of relatively impermeable clay lenses within the sands. However, the shallow sand unit of the Chicot aquifer system is quite permeable, with hydraulic conductivity on the order of 1.0×10^{-2} centimeters per second (Acres International Corp., 1987). Thus, the formation over the salt dome could provide groundwater at a significant rate of flow, if a water leak into the salt dome were to develop.

The aquifer is known to have highly saturated brine for 10 to 12 feet above the salt. Groundwater then grades to fresh water nearer the land surface. The top of the salt is less than 200 feet below the surface in the main site area, but deeper units within the Chicot aquifer can be used for water supplies near the flanks of the dome. Weeks Island had three wells southeast and northeast of the main site area, two of which are in current use (see Section 7.1.2.2.1). Morton has water wells on the northwest side of the island, near the Intracoastal Waterway. These produce water which varies from 250 to 400 ppm salinity. One is known to be about 300 feet deep. Newer Morton wells on the south side of the island produce "the best water on Weeks Island" with 80 ppm salinity (Leleux, 1988). Thus, groundwater quality is variable adjacent to and over the salt dome.

Details of groundwater use in surrounding parishes are presented in the Weeks Island Final Environmental Impact Statement (SPRO, 1977c), although the information is somewhat out of date.

7.1.3.2 General Description of Pollution Sources/Controls

7.1.3.2.1 Surface Operations

DOE operations at Weeks Island appear to have minimal potential for groundwater contamination because the surface operations are primarily warehouse and maintenance. Shallow groundwater appears to follow topography and flow away from DOE facilities in a manner similar to surface water flow. This statement is based on a limited review of water level contours from measurements in off-site monitoring wells located downgradient of inactive Morton Chemical facilities. In addition to flow direction and water levels, these Morton wells also provide some information on groundwater conditions. Despite the presence of salt piles and salt disposal areas on Morton property, no elevated salinities have been found in these monitoring wells (Leleux, 1988). The wells are located around the chemical facilities, rather than the salt piles and disposal areas, but any generalized contamination could probably be detected. The wells are relatively shallow (30 feet deep) and monitor the uppermost water-bearing units at Weeks Island. Further examination of non-DOE operations and groundwater information related to such operations was beyond the scope of the Survey.

7.1.3.2.2 Brine Accumulation in Fill Hole Sump

Brine is present in unexpected amounts in the sump below the fill holes in the Weeks Island mine. The source of this brine in the fill hole sump remains unknown. Water has been introduced into the mine from at least three known sources. One source is condensation of water vapor produced from propane combustion during inerting (see Section 7.1.1.2). A second source is water contained in suspension in the crude oil. This water is estimated to be as much as 155,000 barrels, on the basis of 0.2 percent BS & W (basic test for sediment and water in oil), but it is unknown how much has actually separated from the oil. A third source is water from hydrotesting of the oil pipeline to St. James. Estimates for the volume of this water range from 16,000 to 500,000 barrels. The total amount of brine present in the mine, without any contribution from water leaks external to the salt dome, could be as much as 660,000 barrels.

It is also possible that the excess brine is a result of an uncontrolled water leak. Under certain scenarios, such a leak (unless remediated) could result in a loss of mine integrity and a release of oil to the environment. SPR is investigating to determine the source of the excess brine and proper corrective action in the event of an uncontrolled water leak.

Current investigative work by SPR, on removal of brine at the fill holes followed by monitoring of the rate of brine inflow, will allow evaluation of the probable source of the inflow and the severity of the situation. Preliminary data from this investigation (Schmedeman, 1988a) suggest that the rate of inflow is steady or decreasing. An increase would be expected from a water leak and the rate of inflow would increase exponentially, as the leak became worse. The salinity of the brine at the fill hole sump is also remaining essentially constant (Schmedeman, 1988b). It would be expected to decrease if a significant fresh water leak were present.

The work already done by the site in investigating this situation has eliminated the possibility of existing leaks into the oil storage area from man-made penetrations such as the fill holes, vent hole, and shafts. The ability to distinguish leaks from condensate will be enhanced, when plans are implemented for installation of equipment to eliminate condensation in the shaft area. Condensation has produced as much as 20 gallons of water per hour during times of high humidity.

The enhanced detection capability for water entry now being developed by the site should provide early warning of potential leak problems, thus giving the site increased response time. This increased response time could allow mine stabilization, identification of leak location, and leak control; thus increasing the site's capability for prevention or mitigation of a potential for release of oil into the environment.

7.1.3.3 Environmental Monitoring Program

There is no groundwater monitoring program at the Weeks Island site. No program is required under the regulatory framework in place at the time of the Environmental Survey.

7.1.3.4 Findings and Observations

7.1.3.4.1 Category I

None.

7.1.3.4.2 Category II

None.

7.1.3.4.3 Category III.

None.

7.1.3.4.4 Category IV

None.

PRELIMINARY

7.2 Non-Media-Specific Survey Findings

This section discusses findings and observations pertaining to waste management, toxic and chemical materials, radiation, quality assurance, and inactive waste sites and releases. These discussions do not include a background environmental information section, because the areas addressed are not necessarily tied to one medium as was the case with the discussions in Section 7.1. These discussions include an environmental monitoring program section, where appropriate, and where information was available.

7.2.1 **Waste Management**

7.2.1.1 Background Information

Operations at the Weeks Island site generate nonhazardous oilfield wastes and nonindustrial solid wastes. They infrequently generate hazardous wastes and do not generate any radioactive, radioactive/hazardous mixed, or industrial solid wastes. Brief descriptions of all of these wastes are as follows:

- Nonhazardous oilfield wastes are wastes generated by the drilling and production of oil and gas wells, and which are not regulated by the provisions of the Louisiana Hazardous Waste Rules (LHWR) (Louisiana Statewide Order No. 29-B). Oilfield wastes include drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy [LHWR 1.3(d)(14)].
- Industrial solid wastes are wastes produced in the course of and resulting from any industrial, manufacturing, or mining process, and which are not subject to regulation under the Louisiana Hazardous Waste Management Plan. Trash, construction debris, and other non-process wastes are not considered industrial solid wastes (Louisiana Solid Waste Regulations, Chapter 3.0).
- Nonindustrial solid wastes include any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded materials, including solid, liquid, semi-solid, or contained gaseous material resulting from commercial and agricultural operations, and from community activities; but does not include or mean solid or dissolved material in domestic sewage or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under Louisiana Revised Statutes (LA R.S.) 30:1094, or source, special nuclear, or

by-product material as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended, or hazardous waste subject to permits under LA R.S. 30:1131 et seq. (Louisiana Solid Waste Regulations, Chapter 3.0).

- Hazardous wastes include any wastes or combination of wastes, which because of their quantity, concentration, physical, chemical, or infectious characteristics may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Such definition shall be applied only to those wastes identified and designated as such by the Department of Environmental Quality, consistent with applicable Federal laws and regulations (Louisiana Hazardous Waste Control Law, LA R.S. 30:1133).
- Radioactive wastes are wastes containing radioactivity (i.e., materials that emit radiation, such as alpha and beta particles, neutrons, electrons, and gamma rays).
- Mixed (radioactive and hazardous) wastes are co-contaminated with radioactive and hazardous waste materials.

Nonhazardous oilfield wastes are regulated by the Louisiana Department of Natural Resources Office of Conservation (LOC). Generators are responsible for the proper handling and transportation of these wastes to an approved commercial facility [Louisiana Statewide Order No. 29-B, Subparagraph 13.2(A)]. All shipments of oilfield wastes for off-site disposal must be accompanied by a properly completed LOC manifest, entitled Oil Field Waste Shipping Control Ticket, that is initiated by the generator (Louisiana Statewide Order No. 29-B, Subparagraph 13.6). The site must also use haulers that are registered with the Louisiana Public Service Commission to transport oilfield wastes. No oilfield wastes are disposed of on-site.

Oilfield wastes are temporarily exempted from regulation as hazardous wastes, under Section 3001(b)(2)(A) of the 1980 Amendments to RCRA, pending further study by EPA. After submission of study results to Congress, and public hearings as well as the opportunity to comment, the Administrator of EPA must determine either to promulgate regulations under the hazardous waste management provisions of RCRA (Subtitle C) or to declare that such regulations are unwarranted. Because wastes generated from activities associated with underground storage of hydrocarbons are considered oilfield wastes, the temporary exemption applies to Weeks Island oilfield wastes. Exempted wastes are defined in detail in the Report to Congress, Management of

Wastes from the Exploration, Development and Production of Crude Oil, Natural Gas, and Geothermal Energy (EPA, 1987a) as well as the Louisiana Hazardous Waste Rules and Regulations [LHWR 1.3(d)(14)].

Nonindustrial solid wastes are regulated by the Louisiana Department of Environmental Quality (LDEQ) Solid Waste Management Division. Generators of these wastes are not required to use manifests for off-site shipments (per Louisiana Solid Waste Regulations). Because none of these wastes are disposed of at Weeks Island, no LDEQ disposal permit is required.

Hazardous wastes are regulated by the LDEQ Hazardous Waste Management Division. LDEQ was granted authority from EPA, in January 1985, to manage the RCRA hazardous waste program in Louisiana. However, because the site generates small quantities of hazardous wastes on an infrequent basis, the site is exempt from the Louisiana Hazardous Waste Rules [LHWR 1.3(d)(1)]. Therefore, Weeks Island requires no waste management permits (e.g., RCRA storage, treatment, and disposal permits); nor does it require an EPA waste generator identification number or need to submit generator reports. Before Louisiana was granted RCRA authority, EPA issued the site generator number LA9890032585 in response to SPR's 1980 Part A RCRA Section 3005 notification; but then reclassified the site to nonhandler status in June 1982 because it was a small quantity generator (Paul, 1982). If the site generates a hazardous waste, it must request from LDEQ a one-time-only EPA identification number to manifest and dispose of that waste off-site (LHWR 7.3). Quantities generated and accumulated on-site are subject to limitations established for small quantity generators [LHWR 1.3(d)(1)]. The site must also use haulers for hazardous wastes who are specifically registered with the Louisiana Public Service Commission and who possess an EPA identification number [LHWR 7.3 (c)].

7.2.1.2 General Description of Pollution Sources/Controls

7.2.1.2.1 Nonhazardous Oilfield Wastes

Nonhazardous oilfield wastes generated at the Weeks Island SPR consist of brine and oil spill cleanup wastes. Brine is held on-site in aboveground tanks and shipped off-site in vacuum trucks. Cleanup wastes (e.g., oil-contaminated soil and oily sorbent pads) are collected in vacuum trucks or drums and shipped off-site. Spilled oil that is recovered is returned to storage. Drilling muds and salt cuttings (which were generated during the drilling of the fill and vent holes and are considered nonhazardous oilfield wastes) also were shipped off-site for disposal. Site personnel believe that the Oilfield Brine Disposal facility in Abbeville, Louisiana, was used.

Brine is not intentionally produced at Weeks Island. It is generated when water comes into contact with the salt in the mine. At the time of the Survey, brine was accumulating in two areas: behind the mine bulkheads and in the fill hole sump. The source of water that accumulates as brine behind the bulkheads was found to be condensation. The source of the water in the fill hole sump was being investigated (refer to Section 7.1.3.2.2). Condensation brine is pumped into drums, taken out of the mine, and held in two above-ground tanks located outside the production shaft. When the tanks are almost full, the brine is shipped off-site for disposal as nonhazardous oilfield waste. A review of LOC manifests revealed that during 1987, 628 barrels (26,376 gallons) of condensation brine were shipped to the Oilfield Brine Disposal facility.

It has been estimated that approximately 28,000 barrels (1,176,000 gallons) of brine accumulated in the fill hole sump. This accumulation was discovered in April 1987 and SPR started to pump out brine from the fill holes in June 1987. At the time of the Survey (February 1988), approximately 23,600 barrels (991,200 gallons) had been pumped out. The brine was being pumped into a frac-tank that functioned as an oil/water separator. The separated oil was returned to storage and the brine was pumped to one of three other frac-tanks. Approximately 600 gallons of oil were collected and returned to storage. Brine was shipped to the following four sites for disposal:

- Sulphur Mines SPR facility for underground injection.
- Oilfield Brine Disposal facility in Abbeville, Louisiana.
- Campbell Wells facility in Mermentau, Louisiana.

Weeks Island and the other Capline SPR sites (i.e., Bayou Choctaw SPR and St. James Marine Terminal) currently use the following four commercial nonhazardous oilfield waste disposal facilities:

- Oilfield Brine Disposal, Inc., in Abbeville, Louisiana.
- Reliable Production Services in Livonia, Louisiana.
- Intracoastal Oilfield Fluids in Bourg, Louisiana.
- Campbell Wells in Mermentau, Louisiana.

It is DOE's policy to only send waste to commercial sites that have been used extensively in the past by DOE SPR contractors and that do not have any outstanding compliance orders (i.e., that are well-known to DOE and that have a long history of successful operation; Russell, 1988a). According to site personnel, operations at these sites and the sites' regulatory statuses are routinely reviewed by SPR personnel and approved for use. This policy is also to be followed by subcontractors working under BPS, where BPS fills out the Oil Field Waste Shipping Control Ticket. Such a policy will reduce

DOE's potential future liability as a "responsible party," in the event that a commercial disposal facility used will have to be cleaned under a CERCLA action

7.2.1.2.2 Nonindustrial Solid Wastes

Nonindustrial solid wastes include trash, grout additive, construction rubble and spoil, and chemical toilet waste. Trash and construction wastes are disposed of in dumpsters or directly into trucks and hauled off-site. The site uses two local landfills: the Waste Management, Inc. landfill in Lafayette, Louisiana, and the Acadian landfill in Baton Rouge, Louisiana. Waste grout additive is stored at the laydown yard and in the flammable liquids storage shed at the production shaft, awaiting shipment off-site. SPR was attempting to have the distributor for the grout remove this waste. Chemical toilet waste is taken to the local publically-owned wastewater treatment facility via vacuum truck. Operations also generate scrap metal, which is recycled off-site. In addition, a solid waste will be generated from operation of the iron removal system that was being installed at Well 3 during the Survey (see Section 7.1.2.2.1). The volume of solids that would be generated and their characteristics were uncertain (e.g., at the time of the Survey, it was not known if the waste would exhibit toxic characteristics).

7.2.1.2.3 Hazardous Wastes

Hazardous substances used on-site are generally consumed. Thus, hazardous wastes are infrequently generated. Any hazardous waste generated is shipped off-site for disposal at an approved facility.

At the time of the Survey, hazardous material was on-site awaiting removal and recycling. The flammable liquids storage shed at the production shaft (see Figure 7-4) contained 30 to 40 unused 55-gallon drums of monoacrylamide grout which is used for PB-KBB grouting operations. Monoacrylamide is a RCRA-listed material (40 CFR 261). Several of the old fiber drums that contained the acrylamide material were damaged and would have to be put into oversized shipping drums prior to removal. This hazardous grout additive was not technically a waste, because it was not outdated and still could be used. However, if the expiration date were to pass, the material would technically be considered a waste and then must be shipped off-site within 90 days. If SPR were to dispose of these materials as wastes, it also would have to obtain a hazardous generator number for the wastes and use a LDEQ manifest.

Hazardous and toxic wastes (one each) have been generated and shipped off-site for disposal (Little, 1986). In December 1981, twelve 55-gallon drums of PCB-contaminated liquid, five 55-gallon drums of PCB-contaminated articles, and a drained and flushed transformer were taken to the

Chemical Waste Management, Inc. facility in Emelle, Alabama by Peterson Maritime Services. Liquids in 9 of the 12 drums had PCB concentrations less than 500 ppm. Liquids in the other three drums had concentrations greater than 500 ppm (also refer to Section 7.2.2.1.3). In June 1983, Rollins Environmental Services took six 55-gallon drums of waste paint to their disposal facility in Baton Rouge, Louisiana. Both of these shipments were accompanied with SPR-initiated LDEQ manifests.

Construction and maintenance subcontractors working on-site also sometimes generate small quantities of hazardous wastes (e.g., paint wastes and empty drums of pesticides and herbicides). Their contracts are written so that they retain ownership and responsibility for the removal and proper reclamation or disposal of all unused and waste materials.

7.2.1.2.4 Underground Storage Tanks

There are three underground storage tanks (USTs) at the Weeks Island SPR facility. One of the tanks is an oil collection sump located at the main site; it has a 7,250-gallon capacity. The other two are located at the Laydown Yard; one contains gasoline and has a 1,500-gallon capacity, while the other contains diesel fuel and has a 1,000-gallon capacity. The oil collection sump receives oil from the main site's oil/water separator, which receives runoff from the Main Site Area. Oil collected in the sump is pumped into the mine for storage. A fourth tank was located in the Laydown Yard and contained diesel; its capacity was 500 gallons. It was last used in June 1979 and was removed in July 1987. None of these tanks have been used to store wastes. All were made of steel. However, only the oil collection sump is known to have cathodic protection. At the time of the Survey, all tanks were under 10 years old. Although SPR does not have a leak detection program for USTs, the potential for UST leakage appeared to be low and, at this time, does not present a significant environmental risk. In addition, all four USTs were reported to the state per RCRA Subtitle I requirements (Teerling, 1986d). SPR also notified the state that the one diesel tank was removed (Teerling, 1987j).

According to site personnel, the oil/water separator and the oil collection sump accumulate very small quantities of tank bottoms. The runoff into the system comes off cement surfaces. Hence, no appreciable amount of sediment enters the system. The oil/water separator and the oil collection sump have not needed to be cleaned out. Thus, no bottoms have been collected for disposal.

7.2.1.3 Findings and Observations

7.2.1.3.1 Category I

None.

7.2.1.3.2 Category II

None.

7.2.1.3.3 Category III

None.

7.2.1.3.4 Category IV

None.

PRELIMINARY

7.2.2 Toxic and Chemical Materials

7.2.2.1 General Description of Pollution Sources/Controls

7.2.2.1.1 Toxic Management

The control of toxic and chemical materials at Weeks Island is the combined responsibility of the Purchasing, Quality, Safety, and Environmental Departments. The Capline Environmental Specialist for Weeks Island has informed the Purchasing Department representative for the site that Material Safety Data Sheets (MSDS) must accompany any shipment of toxic and chemical materials received at Weeks Island (Russell, 1988b).

An inventory of the toxic and chemical materials used at the site and the MSDSs for these materials are maintained at Weeks Island. The Purchasing Department is currently responsible for circulating purchase requisitions to representatives of the Weeks Island Safety and Environmental Departments for review. This manual method of approving purchase requisitions was being phased out at the time of the Environmental Survey and replaced with a computer-based system called the Materials Management System. The Environmental Department can reject the purchase or use of a particular hazardous material at Weeks Island due to potential environmental or occupational health concerns.

Four locations are used for the storage of toxic and chemical materials at Weeks Island: the Warehouse, Laydown Yard, Flammable Storage Building, and the Production Shaft Storage Shed (Figure 7-5). These locations were inspected during the Environmental Survey and no deficiencies regarding the storage of toxic and chemical materials were noted at the Warehouse. However, at the Laydown Yard, drums containing chemical products are currently stored out-of-doors and are unprotected from adverse weather conditions (i.e., lacks a roof and walls) at locations lacking impervious flooring and curbing to contain spills. In the event of a drum leak or rupture, spilled substances would contaminate surrounding soils and could be released into nearby surface waters. The Laydown Yard at Weeks Island contains three areas (i.e., the Drum Storage Area, Excess Area, and PB-KBB Area) where materials are stored out-of-doors without protection, flooring, or curbing. At the time of the Environmental Survey, the Drum Storage Area contained approximately five 55-gallon drums of corrosion inhibitor, 2 drums of methyl ethyl ketone, 2 drums of solvents, 2 drums of oil, 3 drums of herbicide, and 4 drums of antifreeze. The Excess Area contained approximately six 55-gallon drums of styrene butadiene, six 5-gallon containers of a naphthalene-based chemical, and two 5-gallon containers of solvent. Sixteen 55-gallon drums of various chemicals and 2 drums of solvents were stored in the PB-KBB Area.

FIGURE 7-5

STORAGE AREAS FOR TOXIC AND CHEMICAL MATERIALS AT WEEKS ISLAND STRATEGIC PETROLEUM RESERVE

A Flammable Storage Building was recently constructed at Weeks Island but was empty at the time of the on-site Survey. However, a dike (i.e., a secondary containment measure in the event of a spill, overflow, tank rupture, etc.) or other means of spill containment was not constructed at the doors to the building. In the event of a spill, materials could be released to the environment.

Finally, toxic and chemical materials are stored without secondary containment at the Production Shaft Storage Shed. This facility is not equipped with an impervious floor or curbing. At the time of the Environmental Survey, approximately thirty-five 55-gallon drums of toxic material (containing 95 percent acrylamide monomer) and thirty-five 5-gallon containers of various materials (primarily epoxy resins and binders, rhodamine dye, and floor hardener) were stored in the shed.

Deficiencies regarding the storage of toxic and chemical materials were previously identified during an EPA inspection of the Weeks Island site (Townsend, 1986), the DOE-PMO Site Management Appraisal at the St. James Marine Terminal (Wagoner, 1987), and in an environmental audit of the Weeks Island site conducted by the operating contractor (Teerling, 1987k). Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous waste) drum storage areas, such measures are considered good management/operational practice. A request to install covered drum storage racks at all SPR sites was submitted to DOE by BPS, but was not authorized (Teerling, 1987d). BPS is in the process of submitting similar requests to DOE to construct such facilities on a site-specific basis. The request for Weeks Island was initiated in January, 1988 (Russell, 1988c).

At present, Weeks Island relies upon the labels placed upon containers of toxic and chemical materials by the manufacturer to inform workers of the potential hazards associated with these materials. Regular inspections are conducted to determine if these labels are present. However, Weeks Island is considering the implementation of a site-specific labeling system for this purpose. Although not required by current regulations, in general, site-specific labeling systems are increasingly being used on a voluntary basis to facilitate compliance with such regulations. In addition, BPS has established formal procedures to comply with the requirements of the OSHA Hazard Communication Standard and similar requirements imposed by Louisiana (BPS, 1987b).

7.2.2.1.2 Tank Farm Facilities

Underground Storage Tanks

Three USTs were present at Weeks Island at the time of the Environmental Survey (Teerling, 1986d). A fourth UST had been removed previously. None of the four tanks were used to store waste. For a complete discussion of the USTs at Weeks Island, see Section 7.2.1.2.4.

Above-Ground Storage Tanks

There are two above-ground storage tanks at Weeks Island used to store petroleum products. These include

- A 1,500-gallon capacity diesel tank at the emergency generator. A secondary containment dike has not been constructed around this tank.
- A 500-gallon capacity diesel tank inside the fire-water pump building. In the event of a spill or tank rupture, diesel fuel would enter the drain in the building that discharges to the natural surface drainage (BPS, 1986g) and flow off-site.

7.2.2.1.3 Spill Prevention, Control, and Countermeasures (SPCC) Plan

The Weeks Island site handles large volumes of crude oil and is located close to navigable waters. As a result, the requirements of the EPA Oil Pollution Prevention regulations (40 CFR 112) are particularly applicable to the site. In response to these requirements, Weeks Island has prepared and implemented an SPCC Plan (BPS, 1986g) and a Spill Contingency Plan (BPS, 1986h). These documents contain listings of potential spill sources; type and quantity of material that would be released; personnel and equipment resources; and spill evaluation, support, and response procedures.

Engineering controls have also been implemented at the site. An oil/water separator in an underground storage tank at the main site area is designed to receive spills from areas throughout the site, including the pig trap, the three main line pumps, and the meter prover station. The meter prover station also rests on a diked concrete pad. At the 255 foot level of the manifold room, a 6-foot-high concrete wall has been constructed to contain spills. The capacity of the wall is sufficient to contain all of the oil that could be released in the manifold room from the service shaft and piping.

An Emergency Response Team (ERT) has been organized at Weeks Island. All ERT members receive 40 hours of training at the ERT Academy at Lamar University (Russell, 1988d). Some ERT members have also attended 40 additional hours of training on oil spill control and cleanup at Texas A&M University at Galveston. An inventory of spill control equipment is maintained at the site.

Formal monthly inspections of the site for deficiencies related to spill prevention and control are performed by the Weeks Island Environmental Specialist (BPS, 1986g). The Specialist's inspection report is forwarded to the Weeks Island Site Manager for review and approval. SPR has established formal reporting requirements for oil spills of one or more barrels or any quantity on navigable waterways. Similar reports must be prepared for brine spills of any quantity leaving the site or five or more barrels on-site. For spills of hazardous substances, the reporting requirements established by EPA have been implemented. During CY 1986, no reportable oil or brine spills occurred at Weeks Island (Teerling, 1987e).

7.2.2.1.4 Polychlorinated Biphenyls (PCBs)

It is the policy of SPR not to permit any equipment that is known to contain fluids with a PCB concentration in excess of 5 parts per million (ppm) on any SPR site (BPS, 1987e). There are currently six oil-filled transformers at Weeks Island. When the oil in these transformers was tested in 1981, it was shown to contain less than 1 ppm PCBs (Fisher, 1983a). According to these results, the six oil-filled transformers at Weeks Island are non-PCB transformers.

No PCB-containing, pole-mounted transformers, capacitors, or circuit breakers are known to be present at Weeks Island.

In 1980, 17 oil-filled transformers were being stored in the Weeks Island Laydown Yard (Leemann, 1980). One of these transformers was filled with PCB oil (with a concentration of PCB greater than 500 ppm), another was a PCB-contaminated transformer (with a PCB concentration between 50 and 500 ppm), and the remaining 15 transformers were non-PCB transformers (Leemann, 1981b). Of the 15 non-PCB transformers, 11 had PCB concentrations of less than 1 ppm. In 1981, Weeks Island retained a contractor to drain the 6 transformers that contained more than 1 ppm PCB. These fluids, and the drained PCB transformer, were disposed at a Chemical Waste Management, Inc., facility in Emelle, Alabama (Bozzo, 1981).

7.2.2.1.5 Pesticides

Pesticides (i.e., insecticides, herbicides, and rodenticides) are used at Weeks Island and are applied by both site and contractor personnel. Restricted-use pesticides (i.e., pesticides that, according to EPA, must be applied only by a certified pesticide applicator or persons directly supervised by a certified pesticide applicator) are used only by contractor personnel who are licensed to handle such materials (Teerling, 1987f). Currently, essentially all of the pesticides used by site personnel are for mosquito control (i.e., Vaporizer X-T and Therafog RTU). However, some spot spraying of herbicides for weed control is conducted by Weeks Island personnel. Because the mosquito populations in the Weeks Island area are abundant, spraying of pesticides for mosquito control is performed frequently. Written procedures governing the use of pesticides at Weeks Island have not been established; however, records of spraying conducted to control mosquitoes are maintained. Site personnel indicated that pesticides are applied in accordance with the directions on the pesticide container labels.

The supply of pesticides used at Weeks Island is stored out-of-doors in the Drum Storage Area of the Laydown Yard. As described in Section 7.2.2.1 above, this location is unprotected from adverse weather conditions and lacks an impervious floor and curbing to contain potential spills. Any mixing of pesticides required prior to application is performed at the Maintenance Shop.

In addition to herbicides that are applied by personnel at the site, a crew stationed at St. James Terminal is responsible for spraying herbicides at road crossings and valve stations on the Weeks Island, Bayou Choctaw and St. James Terminal crude oil pipelines, and the Bayou Choctaw brine discharge and raw water intake lines. Herbicide 2,4-D is used for this purpose. Application records are not maintained. A commercial aerial spraying contractor is also used to spray herbicides (i.e., Tordon K and Esteron 99) along the entire length of these pipelines. This contractor meets all the requirements for aerial herbicide spraying mandated by the Louisiana Department of Agriculture (Calhoun, 1986).

7.2.2.1.6 Asbestos

SPR operations began in the late 1970s. As a result, the various SPR sites, including Weeks Island, were constructed using relatively little asbestos-containing materials. Asbestos-containing gaskets are in place on the SPR pipelines and SPR has established procedures for properly removing and disposing of these asbestos-containing gaskets during routine maintenance (BPS, 1986c). These procedures will be utilized at Weeks Island until all asbestos-containing gaskets have been properly removed, disposed, and replaced with asbestos-free gaskets.

7.2.2.1.7 Chlorofluoroalkanes

Approximately 300 pounds of chlorofluoroalkanes are used at Weeks Island annually (Teerling, 1987h). These materials are used primarily to clean electrical parts. As a group, the chlorofluoroalkanes are relatively volatile compounds. Potential environmental problems due to vapor emissions can result, if these compounds are not properly handled and stored. All of the chlorofluoroalkane purchased by Weeks Island in 1987 was CFC-113. This supply of CFC-113 is stored indoors at the Warehouse at the Laydown Yard until needed. During the Environmental Survey, chlorofluoroalkanes appeared to be stored properly at Weeks Island.

7.2.2.2 Findings and Observations

7.2.2.2.1 Category I

None.

7.2.2.2.2 Category II

None.

7.2.2.2.3 Category III

1. Inadequate Secondary Containment Measures. There is a potential for releases of oil and chemical materials into the environment from above-ground tanks and drum storage areas lacking effective spill containment. Drums containing chemical products are currently stored out-of-doors, unprotected from adverse weather conditions at locations lacking impervious flooring and curbing to contain spills. In the event of a tank/drum leak or rupture, spilled substances would contaminate surrounding soils and could possibly be released into nearby surface waters. These deficiencies were identified during an EPA inspection of the Weeks Island site, the DOE Site Management Appraisal at the St. James Marine Terminal, and in an environmental audit of the Weeks Island site conducted by BPS. Although neither state nor Federal regulations currently require secondary spill containment for certain (i.e., nonhazardous waste) above-ground tanks and drum storage areas, such measures are considered good management/operational practice.

Deficient storage of chemical products and wastes noted by the Environmental Survey team include

- Storage of about thirty-five, 55-gallon drums of toxic material (containing 95 percent acrylamide monomer) in the Production Shaft Storage Shed at Weeks Island. This shed is not equipped with an impervious floor or curbing. This shed also holds about thirty-five 5-gallon containers of various materials, primarily epoxy resins and binders, rhodamine dye, and floor hardener.
- The Laydown Yard at Weeks Island contains three areas where materials are stored out-of-doors without protection, flooring, or curbing. The Drum Storage Area contains eighteen 55-gallon drums of corrosion inhibitor (5 drums), methyl ethyl ketone (2 drums), oil (2 drums), herbicide (3 drums), antifreeze (4 drums), and solvents (2 drums). The Excess Area contains about six 55-gallon drums and 5-gallon containers of various chemicals as well as two 5-gallon containers of solvents. The PB-KBB Area contains eighteen 55-gallon drums of various chemicals (16) and solvents (2).
- Two above-ground diesel storage tanks are not diked at Weeks Island: the 1,500-gallon emergency generator tank and the 500-gallon tank for the fire water pump. In the event of a spill or tank rupture of the 500-gallon tank, diesel fuel would enter the floor drain in the building that discharges to the natural surface drainage.
- The new Flammable Storage Building at Weeks Island is not equipped with a dike or other means of spill containment at the doors. At the time of the on-site portion of the Environmental Survey, this building was not in use.

7.2.2.2.4 Category IV

None.

7.2.3 Radiation

There are no radioactive materials at Weeks Island. The site does not have any gamma-ray densitometers or sulfur analyzers. There have been no well-logging sources lost at Weeks Island.

PRELIMINARY

7.2.4 Quality Assurance

7.2.4.1 General Description of Data Handling Procedures

The quality assurance aspects of the environmental monitoring program at the Weeks Island site are governed by the requirements of the BPS Environmental Programs and Procedures Manual (Teerling, 1986c). The requirements of this manual are summarized in Section 3.2.4.1. The environmental monitoring program at the Weeks Island site includes discharge monitoring of the sewage treatment plant, filter-backwash water, and storm-water runoff, as required by the NPDES permit. The environmental water monitoring at Weeks Island is discussed in more detail in Section 7.1.2.3.

There is no laboratory at the Weeks Island site and no analyses, other than pH determinations, are conducted on-site. Weeks Island analyses are generally conducted at the Bayou Choctaw laboratory. Samples may be sent to off-site laboratories, if the Bayou Choctaw laboratory is inoperative or if it is impractical to transfer samples to Bayou Choctaw before the holding time for an analysis (particularly fecal coliform) may be exceeded. Records of sample-custody transfer are maintained at the Bayou Choctaw laboratory. The discussion in Section 8.2.4.2 is applicable to the quality assurance practices associated with the Weeks Island Analyses.

Samples are collected by the Site Environmentalist who has responsibility for Weeks Island, Bayou Choctaw, and St. James Marine Terminal. Samples are either transported directly to the Bayou Choctaw laboratory or to a commercial laboratory. When the latter is necessary, chain-of-custody documentation is maintained.

No sampling was conducted while the Survey team was on-site. The Survey team reviewed the "Sample Log and pH" logbook maintained at Weeks Island. This is a bound notebook that documents sample collections and pH determinations. The inside front cover of the book notes that all samples are transported by Bayou Choctaw, unless there is a sample custody number included with the sample entry. In 1987, six samples were sent to an outside laboratory, the most recent of which was sent on March 3, 1987. The logbook indicated that pH calibrations are made on each day that a pH measurement is taken. The logbook was up to date.

Week Island has a written sampling procedure. This document was reviewed by the Survey team. No deficiencies were noted that would be expected to compromise the quality of the data.

7.2.4.2 Findings and Observations

7.2.4.2.1 Category I

None.

7.2.4.2.2 Category II

None.

7.2.4.2.3 Category III

None.

7.2.4.2.4 Category IV

None.

PRELIMINARY

7.2.5 Inactive Waste Sites and Releases

7.2.5.1 Background Information

The Survey team investigated each of the SPR facilities to identify inactive waste sites and releases of hazardous materials that are sources or potential sources of environmental contamination. Inactive sites and hazardous materials releases reviewed by the Environmental Survey team may either be subject to various environmental regulations or may not be addressed by the environmental regulatory framework. The Survey team identified and inventoried all inactive sites and hazardous materials releases that may cause environmental problems, regardless of the regulatory status of the sites or materials involved. Document reviews, personal interviews, and brief site visits were the basis for the observations and findings described in this section.

Many of the inactive waste sites and releases identified by the Survey team may be subject, via the Federal Facilities provision, to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and associated Executive Orders. Therefore, DOE Order 5480.14 (under revision) was issued on April 26, 1985 to implement DOE's CERCLA Program, which is intended to define actions to identify and evaluate inactive hazardous waste sites on DOE installations and to effect remedial actions, where warranted. The first two phases of a five-phased program, prescribed under DOE Order 5480.14, were completed before the Survey team visited the SPR sites. A report was prepared under each of these two phases--the Phase I CERCLA Report: Installation Assessment, April 1986 (BPS, 1986b) and the Phase II CERCLA Report: Confirmation, April 1987 (BPS, 1987f). According to DOE 5480.14, Phase I was intended to "evaluate site history and records, and to locate and identify those inactive hazardous waste disposal sites that may pose a risk to health, safety and the environment as a result of migration of hazardous substances." Phase II was described by DOE 5480.14 as an effort to "quantify, by preliminary and comprehensive environmental survey, the presence or absence of hazardous substances that may pose a risk to health, safety, and the environment." The Survey team used the Phase I and II CERCLA Reports to aid in identifying and evaluating inactive waste sites and releases.

Since passage of the Superfund Amendments and Reauthorization Act (SARA) of 1986, DOE has revised its CERCLA program and DOE Order 5480.14 to implement the new SARA requirements. DOE has replaced the five-phased program and adopted the Environmental Protection Agency (EPA) program as outlined in the National Contingency Plan. DOE also issued guidance to its facilities on how to use data collected under its old CERCLA program to meet requirements of SARA. Conversion of Phase I CERCLA Reports (i.e., Installation Assessments) to Preliminary Assessments (i.e., the first step under the EPA program) was to be completed by April 1988.

This section summarizes the potential for uncontrolled releases of hazardous substances into the environment from inactive waste sites and spills at Weeks Island. Information was obtained from SPR personnel and files as well as the Phase I CERCLA Report (BPS, 1986a). The Phase II CERCLA Report (BPS, 1987f) does not discuss Weeks Island because no additional investigations were needed beyond the Phase I CERCLA Report. No inactive waste sites or significant releases were identified in the Phase I Report.

7.2.5.2 General Description of Pollution Sources/Controls

The DOE Survey team found no evidence of any inactive waste disposal sites or contaminated areas from past spills and leaks on DOE property at Weeks Island. DOE activities at Weeks Island infrequently generate hazardous wastes (see Section 7.2.1.2). No hazardous wastes have been disposed of on-site, since DOE has occupied the property. DOE activities at Weeks Island have included construction of surface facilities, drilling of two fill holes and a vent shaft, and storage of crude oil in the mine. Drilling muds used on-site contained no hazardous substances (e.g., chrome additives) and were disposed of at approved off-site facilities (BPS, 1986b). Small quantities of hazardous substances and wastes generated by SPR activities at the site have been disposed of twice by DOE and its prime contractor (Little, 1986). In 1981, 12 drums of PCB-contaminated liquid, 5 drums of PCB contaminated articles, and a drained and flushed transformer were taken to the Chemical Waste Management, Inc., facility in Emelle, Alabama by Peterson Maritime Services. In 1983, 6 drums of waste paint were taken to the Rollins Environmental Services disposal facility in Baton Rouge, Louisiana. In addition, construction and maintenance subcontractors working on-site sometimes generate small quantities of hazardous wastes (e.g., paint wastes), but they are responsible for removing such wastes and disposing of them at approved off-site facilities.

No activities conducted on-site prior to DOE acquisition of the property generated hazardous wastes. Also, no hazardous wastes are known to have been disposed of on-site (BPS, 1986b). DOE property was previously owned by the Morton Salt Company. The main site area was formerly occupied by company housing. The mine shafts were used as such by the previous owners. Finally, the Laydown Yard, Fill Area, and Fire-water Area were constructed by DOE in unoccupied, wooded areas. Company housing was removed, beginning in 1968. Sites were left unused until DOE started site development in 1979. The subsurface area has been used only as a salt mine. Former land uses were confirmed by the DOE Survey team through discussions with present and former Morton employees, and examination of a 1968 aerial photograph. No evidence was found to indicate that these areas were used for waste disposal.

Oil spills have occurred on DOE property at Weeks Island, but all spills have been cleaned up. Seven oil spills occurred during 1986 and 1987. The spills were below reportable quantities. Per regulations, all oil spills greater than one barrel (42 gallons) must be reported to the Louisiana Department of Environmental Quality [L.R.S. 30:1073(J)], Act 300 of 1982, as amended by Act 824 of 1984). Review of available information sources (i.e., contractor files, DOE and contractor personnel, and DOE's CERCLA Phase I Report) identified only one reportable spill. This spill consisted of a 50-barrel (2,100-gallon) spill of crude oil, which occurred in 1982 at the main site. The spill was contained on-site by the oil sump and inspection pond, per containment designs. The spilled oil was collected and returned to the mine via the oil sump. Contaminated soils were removed and disposed of off-site at a state-approved facility. A review of SPR spill incident reports revealed that no other hazardous substance has been spilled on-site and that no surface contamination was evident at the time of the DOE Environmental Survey. In general, spill prevention and control measures at the DOE Weeks Island facility are effective (i.e., the potential for spills has been minimized by having as little above-ground piping as possible and past spills that have occurred have been sufficiently remediated).

Surface drainage from areas with active Morton facilities does not flow across DOE property. It also appears that groundwater flows from the center of the salt dome to its edges. Therefore, any contaminated groundwater under Morton property would flow away from DOE property (refer to Section 7.1.3.2.1). In addition, two dumps have been operated by Morton at Weeks Island: one is located northeast of the SPR fire-water tank site and the second is located between the SPR main site and the fire-water tank site. Both were used for disposal of off-specification salt; neither dump was reportedly used to dispose of hazardous waste. Both have also been closed and covered. The dumps are not located on and do not affect DOE property because surface drainage from the dump site does not flow across DOE property. No other waste disposal facilities were operated at Weeks Island, according to Morton (BPS, 1986b).

7.2.5.3 Findings and Observations

7.2.5.3.1 Category I

None.

7.2.5.3.2 Category II

None.

7.2.5.3.3 Category III

None.

7.2.5.3.4 Category IV

None.

PRELIMINARY

8.0 BAYOU CHOCTAW

The Bayou Choctaw site is located in Iberville Parish, Louisiana, about 12 miles southwest of Baton Rouge (Figure 8-1) within the fresh backwater swamp to the west of the natural levee of the Mississippi River. Elevation ranges from approximately 5 to 10 feet above sea level. Although there are no clear topographic expressions in the area, major surface subsidence has occurred, which has created substantial areas of bottomland hardwoods and swamp with interconnecting waterways. The site proper is normally dry and protected from spring flooding by the site's flood control levees and pumps. The collapse of a solution-mined cavern in 1954 resulted in the formation of a 12-acre lake (Cavern Lake) off the north side of the site.

The potential development of the immediate vicinity in and around the Bayou Choctaw salt dome is restricted to activities such as mineral or fuel extraction and/or storage, inasmuch as the physical environment places severe constraints on the types of land use that are feasible. The area immediately surrounding the site is rural. The arable land in this region is used both as pasture for grazing cattle and for raising a limited variety of crops, especially sugar cane, soybeans, and corn. Lumbering is an important industry in Iberville Parish. Several lumber companies and wood products industries are located there.

Four existing brine caverns with a capacity of 46 million barrels were acquired in 1977 and converted to oil storage. A fifth existing cavern was acquired in 1985, which increased the storage capacity to 56 million barrels. A new 10 million barrel cavern is under construction, and expansion of an existing cavern (No. 18) by 6 million barrels is planned. The cumulative storage capacity, when complete, will be 72 million barrels and will provide for a drawdown capability of 480,000 barrels per day (DOE, 1986a and 1987).

8.1 Media-Specific Survey Findings

The discussions in this section pertain to existing or potential environmental problems in the air, surface water, and groundwater/soil media. The discussions include a summary of the available background environmental information related to each medium, a description of the sources of pollution and their control techniques, a review of the environmental monitoring program specific to each medium, and a categorization and explanation of the environmental problems found by the Survey team related to each medium.

FIGURE 8-1

**BAYOU CHOCTAW, LOUISIANA, SITE LOCATION
STRATEGIC PETROLEUM RESERVE**

8.1.1 Air

8.1.1.1 Background Environmental Information

The air portion of the Environmental Survey of the Bayou Choctaw site is designed to address existing and potential environmental impacts associated with releases of contaminants to the atmosphere, and includes a critical evaluation of air pollution sources and controls, and compliance with air pollution regulations. Adherence to established environmental procedures is evaluated from the standpoint of environmental problems or risks. Principal regulations relating to air emissions used as guidance during the Survey include

- The Clean Air Act (CAA) and Amendments
- Federal Regulations, including
 - National Ambient Air Quality Standards (NAAQS) (40 CFR 50)
 - Standards of Performance for New Stationary Sources (40 CFR 60)
 - National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61)
- Louisiana Air Quality Regulations

The Bayou Choctaw site is located in Iberville Parish, Louisiana, which is included in the Southern Louisiana-Southeast Texas Interstate Air Quality Control Region (AQCR) No. 106 (40 CFR 81.53, July 1, 1987).

The national ambient air quality standards (see Table 3-1) have been incorporated into Louisiana air pollution control regulations and are enforced throughout the state. The attainment status of the Iberville Parish portion of AQCR No. 106 is described (40 CFR 81.319, July 1, 1987) as follows:

Parameter	Status
Total Suspended Particulates	Better than National Standards
Sulfur Dioxide	Better than National Standards
Ozone	Does not meet Primary Standards
Carbon Monoxide	Cannot be classified or better than National Standards
Nitrogen Dioxide	Cannot be classified or better than National Standards

The status of other criteria pollutants, including PM-10 particulate matter and lead, has not been published.

Wind data recorded at the New Orleans International Airport, which is about 60 miles east of Bayou Choctaw, are representative of air-flow patterns at Bayou Choctaw. Characteristic winds for stations near SPR sites are discussed in Section 2.1.

8.1.1.2 General Description of Pollution Sources/Controls

Because the Bayou Choctaw facility was originally considered by the Louisiana Department of Environmental Quality to be a minor source of air contaminants, no certificate of approval for air emissions was obtained. However, the DOE elected to apply on August 18, 1987, for such an approval (Gray, 1987e). As part of that application, an Emissions Inventory Questionnaire (EIQ) that included information regarding emission sources and estimated emission rates was prepared (Gray, 1987f). The air emission sources (Figure 8-2) covered in the permit application and the EIQ include slop-oil tanks, fuel tanks, the brine pond system, valve stems and pump seals. At the time of the Survey, the permit had not been issued.

8.1.1.2.1 Slop-Oil Tanks

Two tanks that are used at Bayou Choctaw as receivers of slop oil are potential sources of VOC emissions. The first is a 5,000-gallon, above-ground tank that receives oil from oil/brine separation at the brine pond. The second is a 1,000-gallon underground tank that receives oil collected from pump seal leaks and from maintenance operations. Emission controls at both tanks consist of submerged fill pipes, which minimize vaporization of materials entering the tanks. At periodic intervals, the slop oil is injected back into the storage caverns.

8.1.1.2.2 Fuel Tanks

Two 2,000-gallon underground tanks are used for diesel fuel and unleaded gasoline storage. In addition, a 3,500-gallon, above-ground tank and two smaller above-ground tanks (100-gallon and 500-gallon) store diesel fuel. All five fuel tanks are equipped with submerged fill pipes to minimize hydrocarbon emissions during the fill phase.

8.1.1.2.3 Brine Pond System

The brine pond system consists of oil/brine separators and a brine pond that regulates brine flow and removes anhydrite insolubles prior to disposal well injection. Brine drawn from the caverns during crude-oil fill operations or oil recirculation contains relatively small amounts of VOCs, which evaporate into the atmosphere as the brine discharges to the brine pond system.

FIGURE 8-2

LOCATION OF PERMITTED AIR-EMISSION SOURCES AT BAYOU CHOCTAW STRATEGIC PETROLEUM RESERVE

8.1.1.2.4 Valve Stems and Pump Seals

VOC emissions to the atmosphere are possible from leaky valve stems and pump seals. At Bayou Choctaw, cavern fill operations require two valves, whereas drawdown or recirculation operations require the use of 21 valves. Although several crude-oil pumps are provided, only one is required during cavern fill and oil recirculation operations. No crude-oil pumps are required during draw down because oil is displaced by injecting water into the cavern with fresh-water pumps. VOC emissions from valve stems and pump seals are minimized through preventive maintenance. No emission monitoring is required.

8.1.1.2.5 Stationary Diesel Engines

Four stationary diesel engines are located at Bayou Choctaw. Diesel-powered generators at the Central Building and at Building 408 provide electricity to operate computers and for orderly shutdown in the event of a commercial power failure. A diesel-powered pump is a backup to an electric pump that is used to remove flood water from the pad at Cavern 18. The fourth diesel engine powers a pump to provide backup pressurization at the raw-water/fire-water intake. This engine operates only if pressure developed by the electric pump drops below 120 pounds per square inch. Each of the stationary diesels is test run weekly for 30 minutes to ensure that they are operational.

8.1.1.2.6 Unpaved-Road Dust Emissions

Unpaved roads are graded to level, as necessary, and applications of calcium chloride are used at 90-day intervals to minimize fugitive dust emissions, as required by Louisiana Regulation 19.3(b). The road leading into the site (up to main gate) is a public, unpaved road that is not controlled.

8.1.1.2.7 Fire Training Pit

A fire training pit exists at Bayou Choctaw that is used infrequently to train Emergency Response Team personnel. The Louisiana Department of Natural Resources (DNR) has indicated that fire training is within the scope of Air Quality Regulation 11.3.9 and that the DNR has no objections to the open burning (VonBodungen, 1982).

8.1.1.2.8 Space Heating

Space heating at Bayou Choctaw is provided by electricity.

8.1.1.3 Environmental Monitoring

8.1.1.3.1 Monitoring of Ambient Air Quality

A monitoring program was initiated by the site contractor at Bayou Choctaw on October 1, 1982, to determine baseline ambient air-quality. The program continued through September 30, 1983 (York, 1984). Parameters monitored during that period were total suspended particulates, ozone, and nonmethane hydrocarbons (volatile organic compounds). The total suspended particulate concentrations met both primary and secondary annual and 24-hour standards, whereas ozone exceeded the hourly standard (which is not uncommon in an AQCR designated as a nonattainment area for ozone). Although there are no current air-quality standards for nonmethane hydrocarbons, the maximum hourly value was 6.21 ppm (York, 1984). There are no regulatory requirements for continued air-quality monitoring.

8.1.1.3.2 Emission Monitoring

An Emissions Inventory Questionnaire (EIQ) was prepared (Gray, 1987f) for submission to the Air Quality Division of the Louisiana Department of Environmental Quality as part of an application for approval of emissions (Gray, 1987e). The EIQ-calculated VOC emissions are shown in Table 8-1. At the time of the Survey, the Certificate of Approval (Permit) had not been issued.

8.1.1.4 Findings and Observations

8.1.1.4.1 Category I

None.

TABLE 8-1

**CALCULATED VOC EMISSIONS
BAYOU CHOCTAW SITE
STRATEGIC PETROLEUM RESERVE**

	Average Emission Rate, pounds/hour	Maximum Emission Rate, pounds/hour	Annual Emissions, tons/year
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Fill Operations

Brine Pond System	1.492	2.430	6.538
Valves	0.006	0.009	0.026
Pumps	0.058	0.094	0.253

Drawdown Operations

Brine Pond System	0.000	0.000	0.000
Valves	0.036	0.094	0.157
Pumps	0.000	0.000	0.000

Recirculation Operations

Brine Pond System	0.028	3.783	0.908
Valves	0.005	0.092	0.022
Pumps	0.005	0.092	0.022

Fill, Drawdown, Recirculation

5,000-gallon Slop-Oil Tank	0.017	0.018	0.074
1,000-gallon Slop-Oil Tank	0.001	0.002	0.0006
2,000-gallon Gasoline Tank	0.005	0.005	0.021
2,000-gallon Diesel Tank	0.004	0.004	0.017
3,500-gallon Diesel Tank	0.008	0.008	0.033
500-gallon Diesel Tank	0.001	0.002	0.004
100-gallon Diesel Tank	0.001	0.002	0.001

Source: Gray, 1987f.

8.1.1.4.2 Category II

None.

8.1.1.4.3 Category III

None.

8.1.1.4.4 Category IV

None.

PRELIMINARY

8.1.2 Surface Water

8.1.2.1 Background Environmental Information

8.1.2.1.1 Surface-Water Bodies in the Area

The Bayou Choctaw site is surrounded by a freshwater swamp that is interlaced with natural bayous and man-made canals and access channels (Figure 8-3). A 12-acre freshwater lake (Cavern Lake), formed when a solution cavity collapsed in 1954 during uncontrolled leaching, is off the north end of the site. Water from this lake generally flows southward through the site in the North-South Canal to the East-West Canal, which flows westward into Bull Bay and thence to Bayou Choctaw. Bayou Choctaw has been dredged and straightened to form a part of the Port Allen Canal of the Intracoastal Waterway (ICW), which flows north to south approximately one-half mile west of the site. The Port Allen Canal connects the Mississippi River, near Baton Rouge and approximately 12 miles northeast of the site, with the Atchafalaya River and the main east-west portion of the ICW near Morgan City, Louisiana, approximately 40 miles south of the site. The Mississippi River is approximately 5 miles east of the site and the Atchafalaya River approximately 15 miles west of the site.

8.1.2.1.2 Sources of Water Used at the Site

Cavern Lake is used as the source of water for leaching the caverns and for supplying the fire protection system. Bottled water is supplied for drinking. Well water from two on-site wells is used for all other requirements on-site (Chatelain and Roberts, 1987).

8.1.2.1.3 Flood Plain

Because of its low surface elevation (approximately 8 feet MSL) the Bayou Choctaw site is subject to flooding. The main area (control room, maintenance building, meter station, pump station, etc.) is protected by a dike. The diked area is indicated on Figure 8-4. The south and west walls of the brine pond and the east-west road through the site serve dual purposes as part of this flood protection dike. Flood pumps located adjacent to the southwest corner of Cavern Pad 18 lift water, which accumulates inside the diked area, into the east-west canal.

FIGURE 8-3

SURFACE WATERS IN THE VICINITY OF BAYOU CHOCTAW
STRATEGIC PETROLEUM RESERVE

FIGURE 8-4

SURFACE-WATER MONITORING POINTS AT BAYOU CHOCTAW
STRATEGIC PETROLEUM RESERVE

8.1.2.2 General Description of Pollution Sources/Controls

8.1.2.2.1 Water Used at the Site

Fire protection water at Bayou Choctaw as well as the water for leaching the caverns and recovering the stored oil comes from Cavern Lake. Screens at the intake structure prevent debris from entering these water systems. The material removed from the screens is disposed of as nonhazardous solid waste.

The fire protection system at Bayou Choctaw, as is done at other SPR sites, uses Aqueous Film Forming Foam (AFFF) to improve the fire-extinguishing capabilities of the system. This material is effective in covering and extinguishing hydrocarbon liquid-based fires. AFFF is obtained from a variety of suppliers through competitive bids, however, all the materials have similar characteristics of high biochemical and chemical oxygen demand (BOD and COD), are mostly biodegradable; contain 5 percent or less fluorocarbon surfactants, which are not biodegradable; and exhibit varying degrees of aquatic toxicity, although they are classified as practically nontoxic in the manufacturer's literature because the oral LD₅₀ for rats is greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered.) The oxygen depletion due to the high BOD and COD, coupled with the aquatic toxicity, could result in short-term environmental degradation if this material were released to adjacent surface waters. The as-purchased concentrate is mixed with water to provide a 3 percent solution to be sprayed on the fire. The foam deluge systems on the pump pads have automatic foam proportioning systems to provide the required mixture. The fire monitors (water cannons) at the cavern pads use eductors to siphon the concentrate directly from drums placed adjacent to the monitor. The mobile fire-fighting equipment is also capable of using AFFF. SPR procedures call for annual testing of the fire protection systems and for training of personnel. SPR has estimated that 18,567 gallons of 3 percent AFFF solution would be generated annually in training and testing exercises at Bayou Choctaw. Because the AFFF is mostly biodegradable, the sewage treatment plant could treat the waste; however, the annual capacity of the existing systems for treating AFFF is only 912 gallons. Retention Pond 1, located at the south end of the HPP Pad, receives run-off water from the pad. This Pond would retain the AFFF discharged from the foam deluge system on the HPP pad. AFFF discharged in fighting fires at the cavern pads would be retained within the dikes at the pads. The fire truck on the site carries 500 gallons of AFFF for use in fighting fires wherever it is needed. The retention of discharges of AFFF from this mobile source would be determined by the location of the fire. SPR has temporarily suspended testing and training requirements until the disposal problem has been resolved. At the time of the on-site portion of the Survey, SPR was continuing dialog with the state and investigating disposal options. Subsequent to the on-site portion of the Survey, the Louisiana

Department of Natural Resources granted permission for the disposal of AFFF into SPR's saltwater disposal wells (Welsh, 1988). A finding relating to a problem with disposal of AFFF is presented in Section 8.1.2.4.3.

The water used for leaching the caverns and for replacing the oil in the caverns when it is taken out of storage or during drawdown exercises, as described in Section 2.2, is eventually discharged as a brine solution. These brine solutions are handled by the brine disposal system described below in Section 8.1.2.2.2.

There are four water wells on-site. Water Well No. 2, located near the trailer complex adjacent to the main gate, supplies water to the sinks and toilets in the trailers. The headspace on the pressure tank at Well No. 2 is pressurized with nitrogen to maintain an inert atmosphere because methane, ethane, and ethylene, which are found in this well's water, could form explosive mixtures with air, in a confined space such as the tank. Table 8-2 shows the results of analyses of the gases in the headspace of the pressure tank at Water Wells 1 and 2 at the site along with the upper and lower explosive limits for these gases. The presence of the gases in the well water does not present a risk to human health or the environment. Neither Well No. 1 at Bayou Choctaw, nor the wells at other SPR sites, contain these gases, which would require similar nitrogen pressurization.

Water Well No. 1 is located adjacent to the maintenance building. It was drilled when the site was constructed and supplies water to the faucets, sinks, and toilets of the main areas of the site as well as seal flush water on the HPP Pad and packing flush water at the oxygen scavenger feed station. There is a backflow preventer installed on the line that supplies the water to the HPP Pad because this well was to supply potable water to the site. A water treatment plant consisting of a chlorinator and a zeolite softener was also installed at this well, but it is not functioning. The discharge for the spent salt solution, used to regenerate the zeolite resin, was connected directly to the brine line from the caverns to the brine pond. However, the pressure in this line was too high to allow the spent regenerant to enter it. Plans are to discharge the regenerant to a sump and pump it from there to the brine pond. This will allow the use of this treatment system.

Two additional wells are located by Brine Disposal Wellpads 2 and 3. These wells are used only to supply water to the drilling rigs (for making up drilling fluids) when the disposal wells are being worked over. The wastes are collected in frac-tanks to be hauled off-site and disposed of as oilfield wastes.

TABLE 8-2

GASES IN WATER-WELL PRESSURE TANK HEADSPACE
BAYOU CHOCTAW SITE
STRATEGIC PETROLEUM RESERVE

Gas	Percent of Gas by Volume			
	Water ⁽¹⁾ Well No. 1	Water ⁽¹⁾ Well No. 2	Lower ⁽²⁾ Explosive Limit	Upper ⁽²⁾ Explosive Limit
Methane	0.07	30.3	5.3	15.0
Ethane	0.002	19.5	3.0	12.5
Ethylene	<0.001	0.3	2.7	36.0

Sources: (1) Dobson, 1987.
(2) Sax, 1984.

8.1.2.2.2 Brine Disposal

Brine produced in the cavern leaching and filling operations at Bayou Choctaw is disposed of by injection into wells. Brine from the leaching operation is delivered directly to the brine pond to allow insoluble material to settle out. An oil boom on the inlet side of the brine pond is sufficient to remove any oil from the leaching operation. Because of the greater potential for oil in the brine from filling operations, brine from filling operations first passes through an oil/brine separator before going to the brine pond. Anhydrite accumulation in the oil/brine separator is not a problem at Bayou Choctaw during filling because a cavern is not filled with oil until it has been completely leached.

The effluent from the brine pond passes through multimedia filters to remove insoluble material that does not settle out in the brine pond. Water-soluble organic polymers are added to the line ahead of the filters to increase the removal efficiency and enhance the flow rate through the filters. Solids that accumulate on the filters are backwashed into the brine pond. The filter effluent also passes through cartridge-type polishing filters at each injection well prior to entering the ground. Each of the three injection wellpads have two tanks. One tank holds fresh water to be used in servicing the filters. The other is used to collect the brine that drains from the system and wastewater generated when servicing the filters. The contents of the waste tanks are trucked to the oil/brine separator or the brine pond.

8.1.2.2.3 Sanitary Sewage

There are two packaged, extended aeration, sewage treatment plants (STP) and a sanitary sewage holding tank at Bayou Choctaw. Both the STPs have a rated capacity of 1,500 gpd. The one serving the main site area receives about 1,800 gpd, whereas the one at the main gate trailer complex only receives about 500 gpd. Their effluents are NPDES Outfalls 002 and 001, respectively. The trailer complex plant was not operating within the limits of the NPDES permit at the time of the on-site Survey because the disposal of pine oil cleaner in the system had killed the microorganisms needed to properly treat the sewage. The effluent from this plant was being hauled away for off-site treatment and disposal until the plant was functioning properly again. The same contractor who regularly empties the 1,000-gallon sanitary sewage holding tank at the security operations center was taking the trailer complex sewage plant effluent. Prior to this upset, operating problems with the blower at the trailer complex sewage treatment plant caused one noncompliance in 1986 and three noncompliances in 1987. The primary cause of the continuing difficulties at this sewage treatment plant is the infrequent operation of mechanical parts due to the low waste load to the

unit. Cleaning personnel have also been cautioned about dumping cleaning agents into the sewer system, and the cleaning agents which they use have been closely regulated by the site.

8.1.2.2.4 Storm Water

Storm water from Bayou Choctaw runs off-site into the adjacent wetlands or into the two canals that traverse the site and flow into the Port Allen Canal of the ICW. Those areas, such as cavern well pads and pump pads, that have the greatest potential for having oil or brine spills are diked and the storm water discharges through an oil/water separator. The oil/water separators are operated in a batch mode, that is, storm water is not discharged from the pad through the oil/water separator until after the water has been analyzed and found to meet the NPDES discharge limits discussed later in Section 8.1.2.3.1. Furthermore, if any of the storm waters contain greater than 1 ppt salinity, they are taken to the brine disposal system for handling and ultimate disposal.

Cavern Pad 17 is the only one on-site in which an asphalt emulsion was used in its construction. The storm water that accumulated on this pad had to be hauled off-site for disposal at a commercial facility until the emulsion stabilized and was no longer leaching into the water.

8.1.2.3 Environmental Monitoring Program

8.1.2.3.1 NPDES Monitoring

The surface water discharges at Bayou Choctaw are regulated by NPDES Permit LA0053040 issued by the USEPA on August 9, 1981, with an expiration date of March 12, 1983, and Water Discharge Permit No. WP0179 issued by the Louisiana Department of Environmental Quality (LDEQ) on July 22, 1983, with no listed expiration date. The SPR files include a letter from EPA dated April 7, 1983, acknowledging receipt of a permit renewal application and also copies of additional permit renewal applications submitted to both LADEQ and EPA on November 9, 1987. The locations of the 12 permitted discharge points are shown on Figure 8-4 and are listed in Table 8-3.

Bayou Choctaw has requested in the November 9, 1987, renewal application, that Outfalls 008 and 009 (Mini-Leach Fuel Tank Pads) be removed from the permit because the tanks have been removed. The monitored parameters, their limits, and the monitoring requirements for each of the 12 permitted outfalls are listed in Table 8-4. The only exceedance of these limits during 1986 was a BOD level of 81.5 mg/L as compared to a daily maximum limit of 45 mg/L at the 001 outfall (main gate trailer complex sewage treatment plant). This exceedance was caused by a malfunction of the blower used to supply air for the activated sludge process used to treat the sewage.

TABLE 8-3

**WATER SAMPLING LOCATIONS
BAYOU CHOCTAW SITE
STRATEGIC PETROLEUM RESERVE**

NPDES Discharge Monitoring Stations	
001	Discharge from the Sewage Treatment Plant at the Trailer Complex
002	Discharge from the Sewage Treatment Plant at the Main Site Administration Building
003	Discharge Point from the Oil/Water Separator at the High-Pressure Pump Pad/Meter Prover
004	Storm-Water from Well Pad 15
005	Storm-Water from Well Pad 18
006	Storm-Water from Well Pad 19
007	Storm-Water from Well Pad 20
008	Northern Mini-Leach Fuel Tank Pad
009	Southern Mini-Leach Fuel Tank Pad
010	Weak Brine Pump Pad
011	Weak Brine Fuel Tank Pad
012	Emergency Generator Fuel Tank Pad

Water Quality Monitoring Stations	
A	Canal North of Cavern Lake at Freeport Road
B	Drainage Ditch to North South Canal
C	East-West Canal at Intersection of Road to Brine Disposal Wells
D	East-West Canal at Well Pad 10

Source: BPS, 1987h.

TABLE 8-4

**DISCHARGE MONITORING REQUIREMENTS AND EFFLUENT LIMITATIONS
BAYOU CHOCTAW SITE
STRATEGIC PETROLEUM RESERVE**

Outfall	Parameter	Minimum	Daily Average	Daily Maximum	Measurement Frequency	Sample Type
001 Sewage Treatment Plant	Flow	N/A	Report	Report	1/day	Instantaneous
	Biochemical Oxygen Demand	N/A	30 mg/L 0.4 lbs/day	45 mg/L N/A	1/month	Grab
	Total Suspended Solids	N/A	30 mg/L 0.4 lbs/day	45 mg/L N/A	1/month	Grab
	pH	6.0 SU	N/A	9.0 SU	1/month	Grab
002 Sewage Treatment Plant	Flow	N/A	Report	Report	1/day	Instantaneous
	Biochemical Oxygen Demand	N/A	30 mg/L 0.5 lbs/day	45 mg/L N/A	1/month	Grab
	Total Suspended Solids	N/A	30 mg/L 0.5 lbs/day	45 mg/L N/A	1/month	Grab
	pH	6.0 SU	N/A	9.0 SU	1/month	Grab
003-012 Storm-Water Discharges	Flow	N/A	Report	Report	1/day ^{(1)*}	Estimate
	Oil and Grease	N/A	15 mg/L ⁽²⁾	15 mg/L	1/day ^{(1)*}	Grab
	pH ⁽²⁾	6.0 SU	N/A	9.0 SU	1/day ⁽¹⁾	Grab
	Chloride ⁽³⁾	N/A	N/A	500 mg/L	*	Grab

Source: NPDES Permit LA0053040 and Louisiana Department of Natural Resource Permit WP0179.

* The state requires one sample of each discharge event per month.

(1) When discharging.

(2) Federal requirement only.

(3) State requirement only for Outfalls 010 and 011.

8.1.2.3.2 Surface-Water Monitoring

Although there are no regulatory requirements to monitor the surface-water quality adjacent to the site, Bayou Choctaw takes monthly samples at the four locations identified by letters in Figure 8-4. The results of the analyses of these samples are summarized in the Annual Environmental Monitoring Report that is prepared by BPS for SPR-PMO (Table 8-5). The collection of these samples monitors the effect of the site operations on the adjacent waters.

Parameters monitored in the Bayou Choctaw surface waters included pH, salinity, total suspended solids (TSS), temperature, dissolved oxygen (DO), 5-day biochemical oxygen demand (BOD₅), and oil and grease (O&G). The analytical results presented in the Annual Environmental Monitoring Report for CY 1986 do not indicate any significant adverse effect on adjacent water bodies from site operations.

8.1.2.4 Findings and Observations

8.1.2.4.1 Category I

None.

8.1.2.4.2 Category II

None.

8.1.2.4.3 Category III

1. Potential Oxygen Depletion of Nearby Surface Water From the Discharge of Aqueous Film Forming Foam (AFFF). AFFF is used throughout the SPR because it is effective in covering and thus extinguishing hydrocarbon liquid-based fires. The release of untreated AFFF into surface waters can have an adverse impact on surrounding wetlands. Although the materials available at the SPR sites will vary slightly in composition, they are characteristically classified by the manufacturers as being biodegradable and practically nontoxic, having an LD₅₀ of greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered.) These materials also contain fluorocarbon surfactants (5 percent or less) that are not biodegradable. AFFF materials exhibit varying degrees of aquatic toxicity and have a high biochemical oxygen demand (BOD) and chemical

TABLE 8-5

MONITORING RESULTS ON SURFACE-WATER QUALITY
1986 YEARLY AVERAGES
BAYOU CHOCTAW SITE
STRATEGIC PETROLEUM RESERVE

Parameter	Units	A	B	C	D	Range
Salinity	ppt	0.0	7.9	3.1	0.3	0-30
TSS	mg/L	20.4	5.9	38.2	48.7	2.0-88.0
DO	mg/L	3.6	9.4	5.3	4.0	1.1-15.4
BOD ₅	mg/L	3.4	1.9	5.1	3.5	0.4-10.0
O&G	mg/L	<5	<5	<5	<5	N/A

Source: BPS, 1987h.

TSS Total suspended solids
DO Dissolved oxygen
BOD₅ Biological oxygen demand
O&G Oil and grease

oxygen demand (COD). Therefore, AFFF, if discharged to adjacent surface water, could result in temporary oxygen depletion in those waters in addition to being toxic to some aquatic species. Although there is no restriction on its use in emergency situations, state regulatory agencies require that it be treated prior to discharge when used in training or performance tests. This creates a disposal problem. Under optimum conditions, sewage treatment plants of the types installed at the SPR sites can effectively treat waste AFFF material; however, 18,567 gallons of waste AFFF are expected to be generated annually during training exercises and performance tests at Bayou Choctaw. The treatment plant could handle only an estimated 912 gallons per year. Subsequent to the on-site portion of the Survey, permission was received from the state to dispose of AFFF into SPR's saltwater disposal wells (Welsh, 1988). However, the use of AFFF for training and performance testing purposes has been temporarily curtailed until the waste disposal issue is adequately addressed.

8.1.2.4.4 Category IV

None.

8.1.3 Groundwater/Soil

8.1.3.1 Background Environmental Information

8.1.3.1.1 Site-Specific Geology

The oldest rock units pertinent to Bayou Choctaw operations are thick sands of Miocene age found at depths of 2,500–9,500 feet. These sands contain saline groundwater in the site area and are used for brine disposal off the flanks of the salt dome.

Unconsolidated sediments of Pleistocene through Holocene age are about 400 feet thick over the top of the Bayou Choctaw salt dome and about 1,000 feet thick away from the dome. The names for the Pleistocene sand units differ somewhat from those used further to the west. The lower units are termed the undifferentiated Williana-Bentley Formations, whereas the upper sands are the Gonzales and the Shallow Plaquemine. These upper units, which are separated by the Prairie Clay, form the Plaquemine (or Chicot) aquifer.

The Atchafalaya Clay overlies the Shallow Plaquemine sand unit. This clay is a post-glacial swamp deposit of Holocene age. It is a soft gray clay with minor silt layers and pockets or layers of wood and other organic matter. The Atchafalaya is approximately 60 feet thick and lies at the surface over much of the area. River flood waters have left thin sand layers at the top of the unit (Hogan, 1981).

An important structural feature that affects the geology and hydrogeology of the area is the Baton Rouge fault. This large-scale regional fault lies 5 miles to the north of the Bayou Choctaw site. This normal fault dips toward the Gulf and has a displacement of up to 25,000 feet (Hogan, 1981). (A normal fault is one in which rock units on the upper side of the fault plane are displaced downward relative to those on the lower side of the fault plane.) As discussed below, this fault acts as a hydrologic barrier between the site and the major groundwater use area in the vicinity of Baton Rouge.

8.1.3.1.2 Site-Specific Hydrogeology

The Plaquemine aquifer (equivalent to the Chicot aquifer) is the main source of fresh water for the site and several surrounding municipalities. It extends from the base of the Atchafalaya Clay to a depth of 500 to 600 feet. The interface between fresh water and saltwater occurs at a depth of 400 to 500 feet below the surface in the site area. North of the Baton Rouge fault, this interface is much deeper, and fresh water for industrial and potable supplies is obtained from a 2,000-foot and a

2,800-foot sand of Miocene age. Thus, the Baton Rouge fault acts as an effective hydraulic barrier to saline water migration northward.

The Atchafalaya Clay overlying the aquifer holds water but does not pass it readily. It is much more impermeable than the aquifer and thus acts as a confining layer. The Mississippi River channel is downcut through the Atchafalaya Clay and therefore is in direct hydraulic connection with the Plaquemine Aquifer. Groundwater in the aquifer flows away from the Mississippi during the high river stage and toward the river during the low river stage.

The Bayou Choctaw site has two non-community public water supply wells. These are Water Well No. 1 in the maintenance area and Water Well No. 2 near the hellpad by the main gate. An inactive water well is located near the Cavern 17 wellpad, and two more industrial wells, generally referred to as drilling rig supply wells, are located at brine disposal Wellpads 2 and 3. These latter two are artesian wells in the spring; air-lift pumping is used at other times of the year (Hartley, 1988a). Allied Chemical has a water well within 300 yards of the north boundary of the Bayou Choctaw site. Depths and construction details of these wells are unavailable. In general, they produce fresh water that is high in iron and may contain dissolved gases such as methane. Bottled water is used for potable water at Bayou Choctaw (see Section 8.1.2.1.2).

8.1.3.2 General Description of Pollution Sources/Controls

8.1.3.2.1 Brine Pond

The brine pond is used primarily to collect brine and settle out anhydrite (see Section 8.2.1.2). Although the pond meets regulatory specifications and is constructed of poured concrete over a Hypalon liner placed over lime-stabilized clay, there is no leak detection system, such as an underdrain, and no functional monitoring wells. Leakage would be apparent only if seeps were observed or if problems were noted during pond cleanout. Accordingly, the brine pond at Bayou Choctaw could be an undetected source of groundwater contamination that could contribute, in turn, to surface-water pollution in the surrounding freshwater wetlands.

There appears to be little potential for contamination of the underlying drinking-water aquifer. The Bayou Choctaw site, including the brine pond area, is underlain by Atchafalaya Clay, which is likely to have low permeability and thus to reduce the possibility of contaminant migration downward into the aquifer. However, a shallow groundwater flow system exists near the land surface. In the vicinity of the brine pond, the surface clay layer is disturbed and unstable, a factor which results in increased permeability. It is possible that, in addition, there are sandy clay layers, which would also

have greater permeability. (No borehole logs showing shallow subsurface geology are available for this area.) The increased permeability near the brine pond promotes groundwater discharge into surface water. Such discharge is currently being minimized by the site's pumping of the shallow groundwater system as a control measure for a leak in the lines between the brine pond and the low-pressure brine pump pad sump (see Sections 8.2.1.2.2 and 8.2.5.2.4).

8.1.3.2.2 Brine Disposal Wells

A brine disposal well system consisting of twelve wells on three diked wellpads exists at Bayou Choctaw (see Section 8.2.1.2). The major groundwater concern from brine disposal operations is leakage of brine into freshwater aquifers overlying the brine disposal sands. Such cross-contamination between aquifers is prevented by periodic testing of well integrity. Records for such testing were reviewed during the on-site survey. It appears that the regulations for integrity testing are strictly enforced by the State. All requirements are met by the SPR.

Acid and brine spills can occur at the brine disposal well pads at Bayou Choctaw. (The need for acid treatment is discussed below.) The well pads are diked to prevent lateral migration into the freshwater wetlands, but downward migration is retarded only by the well pad material itself and the underlying clay. At Bayou Choctaw the brine disposal well pads are lime-stabilized soil or soil cement, which provides neutralizing capability for acid spills.

Disposal wells are acidized to keep the sand formations open by removing precipitated salts and reducing clay swelling. The sequence of chemicals used is ammonium chloride (NH_4Cl), hydrochloric acid (HCl), "mud-acid" (hydrochloric plus hydrofluoric acid, $\text{HCl} + \text{HF}$), HCl again, and a final flush of NH_4Cl . The NH_4Cl is a nonreactive "spacer" that "pushes brine out of the way" and allows the acids to react with the formation. It is used at a concentration of 3 percent. HCl is usually 15 percent and mud acid is 12 percent HCl , as well as 3 percent HF . HCl removes iron precipitates from casing corrosion and also reacts with calcium carbonate. HF dissolves silicates and thus etches sand particles. HF cannot be used if large amounts of calcium carbonate are present because insoluble calcium fluoride will be produced. Clay stabilizers may also be added to coagulate fine clays and shrink clays that have swollen from contact with insufficiently saline water. Corrosion inhibitors and bacteriocides/algacides are used under some circumstances. With proper care, spillage of all these solutions can be prevented (Luckianow, 1987; Hartley, 1988a).

8.1.3.2.3 Abandoned Holes and Wells

Abandoned, unplugged test holes, coreholes, and wells resulting from various operations prior to DOE ownership of the SPR sites can serve as direct conduits for contaminant migration from the surface to the groundwater or between aquifers. During the geological site characterization for Bayou Choctaw (Hogan, 1981), attempts were made to document all known wells. These recorded wells are oil and gas wells off the dome (and off DOE property) and wells or boreholes intended for brining operations on the dome itself. It is probable that other holes were drilled for which no records exist and that casings were pulled and the holes allowed to collapse. Thus, conduits for groundwater contamination probably exist, but it is no longer possible to identify or to properly plug such penetrations. Groundwater degradation from this source cannot be evaluated because of the absence of baseline data prior to drilling.

Plugging and abandonment plans for Bayou Choctaw address unused cavern wells, two coreholes (CH1 and CH2) drilled by DOE during early site characterization, and boreholes on DOE property that were drilled by Allied but never used for cavern development. The inactive caverns are 1, 2, 4, 8A, 10, and the coalesced gallery formed from Caverns 3, 11, and 13. (Well 11 is plugged.) The Allied boreholes are 5, 8, 9, and 12, all of which were abandoned due to local subsidence before leaching could begin. It is uncertain whether Hole 12 was plugged and abandoned by Allied.

The abandoned Cavern 10 wellhead was found to contain potassium hydroxide and lead at levels exceeding hazardous waste criteria. The CERCLA investigation of Cavern 10 is described in Section 8.2.5.2.3. Other abandoned wells and holes were also sampled for possible contaminants in preparation for plugging and abandonment. Results are available (Upton, 1988a) for Caverns 1, 2, 3, 8A, and 13, as well as CH1 and CH2. No hazardous materials were found, although the pH at CH2 was high at 11.5. Analyses performed were EP toxicity, total metals, organic priority pollutants, cyanides, phenols, corrosivity, cyanide reactivity, sulfide reactivity, and flash point.

Boreholes 5 and 9 will be sampled by the site when access problems are solved; borehole 5 requires an access road, and borehole 9 is usually underwater. Borehole 8 is known to be covered with a plate. Cavern 4 is a special case. This well was leached into caprock and is considered to be in danger of collapse. A similar situation occurred with Cavern 7, which collapsed to form Cavern Lake. Cavern 4 is currently instrumented to provide a warning in case of surface subsidence, which could possibly be a precursor of cavern collapse. The cavern is known to be in communication with freshwater aquifers because water depth in Well 4 has been found to be sensitive to the water level in the Mississippi River (Linn, 1986). It is probable that no action that could perturb this unstable

system will be taken, or that action will be postponed until successful plugging and abandonment has been carried out elsewhere at Bayou Choctaw.

Since continuing movement of salt (salt creep) could affect a rigid plug in a cavern well, the technical feasibility of plugging and abandoning such wells according to regulations designed for oil and gas wells is debatable. However, the current DOE plan is to follow existing regulations in Statewide Orders No. 29-M and 29-B without further research into the potential effects of salt creep (Mills, 1988).

8.1.3.3 Environmental Monitoring Program

There is no groundwater monitoring program at Bayou Choctaw, and none is required under existing environmental regulations. Two surface penetrations referred to as monitoring wells in various site documents are present in the brine pond area. No logs are available for these penetrations, but they are constructed of PVC leach pipe, are 5 feet and 11 feet deep, and are perforated for the entire length. Since such holes are mixing surface water and shallow groundwater, they provide no information on groundwater conditions and may serve as conduits for surface contamination. Salinities as high as 40 parts per thousand have been measured in these holes.

Salinity measurements at the nearest surface-water sampling station (Station C in the East-West Canal) are normally about 5 ppt at low water-level conditions. This salinity level may actually be an elevated level reflecting discharge of groundwater at low baseflow conditions in the East-West Canal. However, it is considerably lower than the 9-23 ppt and 11-40 ppt salinities found in the monitoring wells during the last sampling in 1984. Surface-water sampling is insensitive as a detector for groundwater contamination; it is known that such surface water sampling did not indicate the known leak between the pond and sump mentioned in Section 8.1.3.2.1.

The BPS environmental staff has considered a groundwater monitoring system with wells upgradient and downgradient of the brine pond to distinguish possible pond leakage from background conditions. However, such a system has not been implemented due to the absence of regulatory requirements.

8.1.3.4 Findings and Observations

8.1.3.4.1 Category I

None.

8.1.3.4.2 Category II

None.

8.1.3.4.3 Category III

1. Lack of Leak Detection at Brine Pond. The brine pond at Bayou Choctaw could be an undetected source of shallow groundwater contamination that could contribute, in turn, to surface-water pollution in the surrounding freshwater wetlands. The brine pond is not equipped with any reliable system that would provide an early indication of a brine leak. Although the brine pond was constructed in accordance with regulatory specifications, it does not have an underdrain system or any functional monitoring wells. Two perforated PVC pipes, referred to as monitoring wells in various site documents, allow surface water and groundwater to mix. These holes may serve as conduits for surface contamination. Brine pond leakage can currently be detected only by observation of visible seepage through the sides of the ponds or observation of pond deterioration during cleanout. The current practice of surface-water monitoring is insensitive as an indicator of salinity increases in groundwater. Undetected pond leakage could lead to brine contamination of shallow groundwater underlying the site and potentially to degradation of the surrounding freshwater wetlands.
2. Potential Cross-Contamination Between Aquifers. Abandoned, unplugged cavern wells, boreholes, and coreholes resulting from various operations at the Bayou Choctaw site can serve as direct conduits for contaminant migration between aquifers. Brine could potentially migrate upward from the salt dome and caprock into shallow formations.

A freshwater aquifer present from the base of the Atchafalaya Clay (approximately 60 feet deep) to a depth of 400 to 500 feet could be affected by brine migration upward from the caprock and salt dome. This aquifer discharges to the Mississippi River when the river is at low water levels, and is recharged by the river at high river water levels. Cavern 4 is known to be in communication with this freshwater aquifer, because water levels measured in the cavern well are affected by changes in the water level of the Mississippi River.

Although the groundwater in this aquifer is fresh, it is not suitable as a potable water source at the site because of high iron and methane content. The site uses this water as an industrial and nonpotable sanitary water supply source. Away from the dome, numerous wells into this aquifer were in existence in Iberville Parish according to Louisiana Water Resource Bulletin No. 16 (Whiteman, 1972). The locations and uses of these wells are not available, and more recent information has not been compiled.

Plugging and abandonment of all unused cavern wells, boreholes, and coreholes at Bayou Choctaw is planned, in conformity with Louisiana Statewide Orders No. 29-M and 29-B. Procedures will be developed on a well-by-well basis, and the work is currently scheduled for FY89 and FY90.

8.1.3.4.4 Category IV

None.

8.2 Non-Media-Specific Survey Findings

This section discusses findings and observations pertaining to waste management, toxic and chemical materials, radiation, quality assurance, and inactive waste sites and releases. These discussions do not include a background environmental information section, because the areas addressed are not necessarily tied to one medium, as was the case with the discussions in Section 8.1. These discussions include an environmental monitoring program section, where appropriate and where information was available.

8.2.1 Waste Management

8.2.1.1 Background Information

Operations at the Bayou Choctaw site generate nonhazardous oilfield wastes and nonindustrial solid wastes. They infrequently generate hazardous wastes and do not generate any radioactive, radioactive/hazardous mixed, or industrial solid wastes. Brief descriptions of all these wastes are as follows:

- Nonhazardous oilfield wastes are wastes which are generated by the drilling and production of oil and gas wells and which are not regulated by the provisions of the Louisiana Hazardous Waste Rules (LHWR) (Louisiana Statewide Order No. 29-B). Oilfield wastes include drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy [LHWR 1.3(d)(14)].
- Industrial solid wastes are wastes produced in the course of and resulting from any industrial, manufacturing, or mining process and which are not subject to regulation under the Louisiana Hazardous Waste Management Plan. Trash, construction debris, and other nonprocess wastes are not considered industrial solid wastes (Louisiana Solid Waste Regulations, Chapter 3.0).
- Nonindustrial solid wastes include any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from commercial and agriculture operations, and from community activities; but do not include or mean solid or dissolved material in domestic sewage or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits

under Louisiana Revised Statutes (LA R.S.) 30:1094, or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended, or hazardous waste subject to permits under LA R.S. 30:1131 et seq. (Louisiana Solid Waste Regulations, Chapter 3.0).

- Hazardous wastes include any wastes or combination of wastes, which because of their quantity, concentration, physical, chemical, or infectious characteristics, may (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Such definition shall be applied only to those wastes identified and designated as such by the Department of Environmental Quality consistent with applicable Federal laws and regulations (Louisiana Hazardous Waste Control Law, LA R.S. 30:1133).
- Radioactive wastes are wastes containing radioactivity (i.e., materials that emit radiation, such as alpha and beta particles, neutrons, electrons, and gamma rays).
- Mixed (radioactive and hazardous) wastes are co-contaminated with radioactive and hazardous waste materials.

In Louisiana, nonhazardous oilfield wastes are regulated by the Louisiana Department of Natural Resources Office of Conservation (LOC). Generators are responsible for the proper handling and transportation of these wastes to an approved commercial facility [Louisiana Statewide Order No. 29-B, Subparagraph 13.2(A)]. All shipments of oilfield wastes for off-site disposal must be accompanied by a properly completed LOC manifest, entitled Oil Field Waste Shipping Control Ticket, which is initiated by the generator (Louisiana Statewide Order No. 29-B, Subparagraph 13.6). Bayou Choctaw must use haulers that are registered with the Louisiana Public Service Commission to transport oilfield wastes. Because some oilfield wastes generated at Bayou Choctaw are disposed of into underground injection wells, the following regulatory requirements must also be met (Allison, 1983):

- Preparation of annual injection well monitoring reports.
- Demonstration of the annular integrity of the disposal wells every 5 years.

- LOC site inspections twice a year.
- Notifications to LOC regarding any pertinent changes or losses, including new well completions, well start-ups, well conversions, and well abandonments or losses that can affect the freshwater aquifers.

In addition, ponds and pits used to hold or dispose of oilfield wastes, such as the Bayou Choctaw brine pond, must be registered, operated and closed in compliance with Subparagraphs 2.3 through 2.7 of Louisiana Statewide Order No. 29-B.

Oilfield wastes are temporarily exempted from regulation as hazardous wastes under Section 3001(b)(2)(A) of the 1980 Amendments to RCRA, pending further study by EPA. After submission of study results to Congress, and public hearings and opportunity to comment, the Administrator of EPA must determine either to promulgate regulations under the hazardous waste management provisions of RCRA (Subtitle C) or to declare that such regulations are unwarranted. Because wastes generated from activities associated with underground storage of hydrocarbons are considered oilfield wastes, the temporary exemption applies to Bayou Choctaw oilfield wastes. Exempted wastes are defined in detail in the Report to Congress, Management of Wastes from the Exploration, Development and Production of Crude Oil, Natural Gas, and Geothermal Energy (EPA, 1987a), as well as the Louisiana Hazardous Waste Rules and Regulations [LHWR 1.3(d)(14)].

Nonindustrial solid wastes are regulated by the Louisiana Department of Environmental Quality (LDEQ) Solid Waste Management Division. Generators of these wastes are not required to use manifests for off-site shipments (Louisiana Solid Waste Regulations). Because none of these wastes are disposed of at Bayou Choctaw, no LDEQ disposal permit is required.

Hazardous wastes are regulated by the LDEQ Hazardous Waste Management Division. LDEQ was granted authority from EPA in January 1985 to manage the RCRA hazardous waste program in Louisiana. However, because the site generates only small quantities of hazardous wastes on an infrequent basis, the site is exempt from the Louisiana Hazardous Waste Rules [LHWR 1.3(d)(1)]. Therefore, Bayou Choctaw requires no waste management permits (e.g., RCRA storage, treatment, and disposal permits), nor does it require an EPA waste generator identification number or need to submit generator reports. Before Louisiana was granted RCRA authority, EPA issued the site generator number LA3890090001 in response to SPR's 1980 Part A RCRA Section 3005 notification but then reclassified the site to nonhandler status in June 1982 because it was a small-quantity generator (Paul, 1982). If Bayou Choctaw generates a hazardous waste, it must request from LDEQ a one-time-only EPA identification number to manifest and dispose of that waste off-site (LHWR 7.3). Quantities generated and accumulated on-site are subject to limitations established for small-

quantity generators [LHWR 1.3 (d)(1)]. To transport the waste off-site, the site must also use hazardous-waste haulers that are specifically registered with the Louisiana Public Service Commission and that have an EPA identification number [LHWR 7.3 (c)].

8.2.1.2 General Description of Pollution Sources/Controls

8.2.1.2.1 Nonhazardous Oilfield Wastes

Nonhazardous oilfield wastes consist of cavern brine, anhydrite, and other solids from the brine pond; tank bottoms; fluids from well workover and pipeline cleaning; storm water that exceeds NPDES discharge limits (off-specification storm water); and oil spill cleanup wastes (e.g., oil-contaminated soil and oily sorbent pads). Drilling muds and salt cuttings are no longer being generated on-site, as all cavern and brine disposal wells have been drilled (past disposal of drilling muds and salt cuttings is discussed in Section 8.2.5.2). Most of the brine and all of the off-specification storm water are disposed of into DOE owned and operated underground injection wells located south of the main site area (Figure 8-5). The off-specification storm water is either pumped into the brine pond and then pumped along with the brine to the injection wells, or is taken directly to the injection wells via vacuum trucks. All of the other oilfield wastes and some of the brine are shipped off-site for disposal by haulers that are registered with the Louisiana Public Service Commission. Spilled crude oil that is recovered is returned to storage.

Bayou Choctaw and the other Capline SPR sites (i.e., Weeks Island and St. James Marine Terminal) currently use four commercial, nonhazardous, oilfield waste disposal facilities:

- Oilfield Brine Disposal, Inc. in Abbeville, Louisiana
- Reliable Production Services in Livonia, Louisiana
- Intracoastal Oilfield Fluids in Bourg, Louisiana
- Campbell Wells on Mermentau, Louisiana

It is DOE's policy to send waste only to commercial sites that have been used extensively in the past by DOE SPR contractors and that do not have any outstanding compliance orders (i.e., that are well known to DOE and that have a long history of successful operation; Russell, 1988a). Operations at these sites and the sites' regulatory status are routinely reviewed by SPR personnel and approved for use. This policy is also to be followed by subcontractors working under BPS in which BPS fills out the Oil Field Waste Shipping Control Ticket. Such a policy will reduce DOE's potential future liability as a

Source: USGS, 1980b

FIGURE 8-5

LOCATION OF BAYOU CHOCTAW BRINE DISPOSAL WELLS STRATEGIC PETROLEUM RESERVE

"responsible party" in the event that a commercial disposal facility used will have to be cleaned under a CERCLA action. Manifests reviewed by the Survey team revealed that all oilfield wastes were shipped to the Reliable Production Services site during 1987 (i.e., approximately 9,200 barrels (386,000 gallons) of brine and sediment from cleaning out (pigging) the brine disposal well lines and approximately 8,500 barrels (357,000 gallons) of brine and sediment from cleaning out the brine pond).

The brine pond (see Figure 8-2) is used primarily to collect brine and settle out anhydrite. During cavern leaching operations, produced brine is pumped directly to the brine pond. When crude oil is being pumped into one of the caverns, brine is pushed out and piped to the oil/brine separators before going through the brine pond. The brine in the pond is then piped to the injection wells. However, the brine is first pumped through multimedia filters located adjacent to the pond and through polishing filters located at the injection wellpads. The brine pond is also used to hold other nonhazardous oilfield wastes (e.g., off-specification storm water, and backwash water and solids generated during cleaning of the multimedia filters). In addition, shallow groundwater contaminated by leaks in brine lines (i.e., between the brine pond and the low-pressure brine pump pad sump) was being pumped and discharged to the brine pond at a rate of 7,200 gallons per day at the time of the Survey (refer to Section 8.2.5.2.4).

The brine pond (see Figure 8-2) is approximately 375 feet by 280 feet by 7 feet (Gray, 1986b) and has a working capacity of approximately 101,000 barrels (4.2 million gallons). SPR submitted a production pit notification for this pond to the LOC Injection and Mining Division in July 1986 (Gray, 1986b). According to site personnel, the pond consists of compacted clay, a layer of limestone, and a Hypalon liner. Gas relief pipes were installed, and in 1982, the liner was covered with 6 inches of reinforced concrete. However, there is no leak detection system, such as an underdrain, and no functional groundwater monitoring wells. Therefore, small leaks into the groundwater could occur undetected. Leakage would be apparent only if seeps were observed or if problems were noted with the concrete/Hypalon lining during pond cleanout. There would be potential for leakage if the lining integrity were damaged (e.g., if local subsidence were to cause small cracks in the concrete and/or small tears in the Hypalon liner). Potential impacts are discussed in Section 8.1.3.2.1 and Section 8.1.3.4.3, Finding No. 1.

There are twelve DOE owned and operated brine disposal wells located on three diked wellpads (Pad 1 has three wells, Pad 2 has four, and Pad 3 has five). These wells discharge to a saltwater aquifer. Injection capacities vary depending on the receiving formation. At the time of the Survey, the site was discharging a total of approximately 130,000 barrels (5,460,000 gallons) per day. The site attempts to apply the same injection rate at all the wells. Each well has a brine polishing filter.

Periodically, wells are acidized to keep the sand formations open (i.e., to remove precipitated salts and to reduce clay swelling; refer to Section 8.1.3.2.2).

8.2.1.2.2 Nonindustrial Solid Wastes

Nonindustrial solid wastes include trash, construction rubble and spoil, chemical toilet wastes, and filter cartridges from the polishing filters at the injection wells. Chemical toilet wastes are disposed of at the local, publicly owned, wastewater treatment facility via vacuum trucks. The other solid wastes are disposed of in dumpsters or directly into trucks that haul the wastes away. The site uses two local landfills: the BFI Colonial landfill located in Sorrento, Louisiana, and the Acadian Waste landfill located in Baton Rouge. During 1986, 780 cubic yards were hauled off-site (Teerling, 1987), and during 1987, 619 cubic yards were hauled off-site (Highland, 1988). Scrap metal is also generated and sent off-site to be recycled.

8.2.1.2.3 Hazardous Wastes

Hazardous substances used on-site are generally consumed, and thus, hazardous wastes are infrequently generated. Any hazardous waste generated would be shipped off-site for disposal at an approved facility. Potential hazardous wastes that could be generated include paint wastes and empty drums of herbicides. If hazardous materials are used by construction and maintenance subcontractors, their contracts are written such that they retain ownership and responsibility for the removal and proper reclamation or disposal of all unused and waste materials.

At the time of the Survey, approximately 60 "excess" acid-filled lead batteries were awaiting removal. The batteries were not technically wastes because they could be recycled. These batteries were being stored on the ground approximately 10 feet from the freshwater swamp at Cavern 10 and represented an environmental risk. A Survey finding related to the storage of these hazardous items is presented in Section 8.2.2.2.3.

8.2.1.2.4 Underground Storage Tanks

There are three underground storage tanks (USTs) at the Bayou Choctaw SPR facility. One of the tanks is a slop-oil tank (BCT-3) located at the pig trap area. The other two are located near the warehouse; one contains gasoline, and the other contains diesel fuel. The slop-oil tank receives oil from the pig trap area and the high-pressure pump pad, and oil collected in this tank is pumped into a cavern for storage. None of the tanks have been used to store wastes. The slop-oil tank has a 1,000-gallon capacity, is made of steel, and has cathodic protection. The two other tanks have a

2,000-gallon capacity and are made of fiberglass-reinforced plastic. At the time of the Survey, all tanks were under 10 years old. Although SPR does not have a leak detection program for USTs, the potential for UST leakage at Bayou Choctaw appeared to be low and does not present, at this time, a significant environmental risk. The three USTs were reported to the state in accordance with RCRA Subtitle I requirements (Teerling, 1986d).

8.2.1.3 Findings and Observations

8.2.1.3.1 Category I

None.

8.2.1.3.2 Category II

None.

8.2.1.3.3 Category III

None.

8.2.1.3.4 Category IV

None.

8.2.2 Toxic and Chemical Materials

8.2.2.1 General Description of Pollution Sources/Controls

8.2.2.1.1 Toxic Management

The control of toxic and chemical materials at Bayou Choctaw is the combined responsibility of the Purchasing, Quality, Safety, and Environmental Departments. The environmental specialist for Bayou Choctaw has informed the Purchasing Department representative for the site that Material Safety Data Sheets (MSDSs) must accompany any shipment of toxic and chemical materials received at Bayou Choctaw (Russell, 1988b).

An inventory of the toxic and chemical materials used at the site and the MSDSs for these materials are maintained at Bayou Choctaw. The Purchasing Department is currently responsible for circulating purchase requisitions to representatives of the Bayou Choctaw Safety and Environmental Departments for review. This manual method of approving purchase requisitions was being phased out at the time of the Environmental Survey and replaced with a computer-based system termed Materials Management System. The Environmental Department can reject the purchase or use of a particular hazardous material at Bayou Choctaw due to potential environmental or occupational health concerns.

The primary locations at Bayou Choctaw used for the storage of toxic and chemical materials are the Warehouse, Flammable Storage Building, the "excess area" at Cavern 10, and the Laydown Yard (Figure 8-6). These locations were inspected during the Environmental Survey, and no deficiencies regarding the storage of toxic and chemical materials were noted at the Warehouse. However, at the newly-constructed Flammable Storage Building, a dike or other means of spill containment has not been provided at the doors to the building. Thus in the event of a spill, materials could be released to the environment. At the "excess area" adjacent to Bayou Choctaw Cavern 10, approximately 60 "excess" acid-filled, lead storage batteries were stored out-of-doors, directly on the ground or on wooden pallets. This location is approximately 10 feet from the freshwater swamp, and in the event of a spill or rupture of these batteries, toxic materials could be released into these surface waters.

At the Bayou Choctaw Laydown Yard, drums containing chemical products and waste materials are currently stored out-of-doors, unprotected from adverse weather conditions (i.e., the storage area lacks a roof and walls) at locations lacking impervious flooring and curbing to contain spills. In the event of a drum leak or rupture, spilled substances would contaminate surrounding soils and could

FIGURE 8-6

STORAGE AREAS FOR TOXIC AND CHEMICAL MATERIALS AT BAYOU CHOCTAW STRATEGIC PETROLEUM RESERVE

be released into nearby surface waters. At the time of the Environmental Survey, the Drum Storage Area in the Laydown Yard at Bayou Choctaw contained approximately thirty-five 55-gallon drums of various chemicals and thirty 55-gallon drums of AFFF.

Deficiencies regarding the storage of toxic and chemical materials were previously identified during an EPA inspection of the Weeks Island site (Townsend, 1986); during the DOE-PMO Site Management Appraisal at the St. James Marine Terminal (Wagoner, 1987); and during an environmental audit of the Bayou Choctaw site conducted by the operating contractor (Teerling, 1987k). Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous waste) drum storage areas, such measures are considered good management/operational practice. A request to install covered drum storage racks at all SPR sites was submitted to DOE-PMO by BPS but was not authorized (Teerling, 1987d). BPS is in the process of submitting similar requests to DOE to construct such facilities on a site-specific basis.

At present, Bayou Choctaw relies upon the labels placed upon containers of toxic and chemical materials by the manufacturer to inform workers of the potential hazards associated with these materials. Regular inspections are conducted to determine if the labels are present. However, Bayou Choctaw is considering the implementation of a site-specific labeling system for this purpose. Although not required by current regulations, in general, site-specific labeling systems are increasingly being used on a voluntary basis to facilitate compliance with such regulations. In addition, BPS has established formal procedures to comply with the requirements of the OSHA Hazard Communication Standard and similar requirements imposed by Louisiana (BPS, 1987b).

8.2.2.1.2 Tank Farm Facilities

Underground Storage Tanks

Three USTs are present at Bayou Choctaw (Teerling, 1986d). None of these USTs are used to store wastes. For a complete discussion of the USTs at Bayou Choctaw, see Section 8.2.1.2.4.

Above-Ground Storage Tanks

There are six above-ground storage tanks at Bayou Choctaw used to store toxic and chemical materials. These include

- A 5,000-gallon capacity slop-oil tank that has not been provided with a spill containment dike as a secondary containment measure in the event of a spill (i.e., overflow, tank

rupture, etc.). However, this tank is equipped with a high-level alarm that notifies the control room when the tank is in danger of overflowing (BPS, 1986i).

- A 250-gallon capacity diesel tank (diked) at the raw-water-intake structure.
- One 4,000 gallon capacity and one 500-gallon capacity diesel tank (both diked) at the emergency generator.
- A 100-gallon-capacity diesel tank at the flood pump structure and a 100-gallon-capacity diesel tank at the disposal wells, neither of which has been provided with a secondary containment dike.

8.2.2.1.3 Spill Prevention, Control, and Countermeasures (SPCC) Plan

The Bayou Choctaw site handles large volumes of crude oil and is located close to navigable waters. As a result, the requirements of the EPA Oil Pollution Prevention regulations (40 CFR 112) are particularly applicable to the site. In response to these requirements, Bayou Choctaw has prepared and implemented an SPCC Plan (BPS, 1986i) and a Spill Contingency Plan (BPS, 1986h). These documents contain listings of potential spill sources, type and quantity of material that would be released, personnel and equipment resources, and spill evaluation, support, and response procedures.

Engineering controls have also been implemented at the site. Containment dikes that drain to sumps equipped with oil/water separators have been constructed at Caverns 15, 17, 18, 19, 20, and 101, and the high-pressure pump pad. The meter prover station rests on a concrete pad equipped with a dike. Spills from the pig trap area and the meter prover station would drain to sumps.

An Emergency Response Team (ERT) has been organized at Bayou Choctaw. All ERT members receive 40 hours of training at the ERT Academy at Lamar University (Russell, 1988d). Some ERT members also attend 40 additional hours of training on oil spill control and cleanup at Texas A&M University. An inventory of spill control equipment is maintained at the site.

Formal monthly inspections of the site for deficiencies related to spill prevention and control are performed by the Bayou Choctaw Environmental Specialist (BPS, 1986i). The inspection report is forwarded to the Bayou Choctaw Site Manager for review.

SPR has established formal reporting requirements for oil spills of one or more barrels, or oil spills of any quantity on navigable waterways. Similar reports must be prepared for brine spills of any quantity leaving the site on five or more barrels on-site. For spills of hazardous substances, the reporting requirements established by EPA have been implemented. During CY 1986 no reportable oil spills and one reportable brine spill occurred at Bayou Choctaw (Teerling, 1987e). The brine spill was contained on-site.

8.2.2.1.4 Polychlorinated Biphenyls (PCBs)

It is the policy of SPR not to permit any equipment that is known to contain fluids with a PCB concentration in excess of 5 parts per million (ppm) on any SPR site (BPS, 1987e). There is no oil-filled electrical equipment at Bayou Choctaw. No PCBs are known to be present at the site.

8.2.2.1.5 Pesticides

Pesticides (i.e., insecticides, herbicides and rodenticides) are used at Bayou Choctaw and are applied both by site and contractor personnel. Restricted-use pesticides (i.e., pesticides that according to EPA must be applied only by a certified pesticide applicator or persons directly supervised by a certified pesticide applicator) are used only by contractor personnel who are licensed to handle such materials (Teerling, 1987f). Currently, essentially all of the pesticides used by site personnel are for weed control (Wipe-Out, Cleanup, and Parmitol 25-E). These herbicides are applied to the cavern pads and limestone fill areas. No spraying of insecticides for mosquito control is conducted at Bayou Choctaw. Written procedures governing the use of pesticides at Bayou Choctaw have not been established. Application records are not maintained. Site personnel indicated that pesticides are applied in accordance with the directions on the pesticide container labels.

A small supply of the pesticides used by site personnel is stored at the Warehouse. This location was inspected during the Environmental Survey and was found to be in an orderly condition, with no evidence of leaks or spills. Any mixing of pesticides required prior to application is conducted at the Maintenance Shop.

In addition to the herbicides that are applied by personnel at the site, a crew stationed at St. James Terminal is responsible for spraying herbicides at road crossings and valve stations on the Weeks Island, Bayou Choctaw, and St. James Terminal crude oil pipelines, and the Bayou Choctaw brine discharge and raw water intake lines. Herbicide 2,4-D is used for this purpose. Application records are not maintained. A commercial aerial spraying contractor is also used to spray herbicides (Tordon K and Esteron 99) along the entire length of these pipelines. This contractor meets all the

requirements for aerial herbicide spraying mandated by the Louisiana Department of Agriculture (Calhoun, 1986).

8.2.2.1.6 Asbestos

SPR operations began in the late 1970s. As a result, the various SPR sites, including Bayou Choctaw, were constructed using relatively little asbestos-containing materials. However, asbestos-containing gaskets are in place in the SPR pipelines. SPR has established procedures for properly removing and disposing of these asbestos-containing gaskets during routine maintenance (BPS, 1986c). These procedures will be utilized at Bayou Choctaw until all asbestos-containing gaskets have been properly removed, disposed, and replaced with asbestos-free gaskets.

8.2.2.1.7 Chlorofluoroalkanes

About 40 pounds of chlorofluoroalkanes are used at Bayou Choctaw annually (Teerling, 1987a). These materials are used primarily to clean electrical parts. As a group, the chlorofluoroalkanes are relatively volatile compounds, and potential environmental problems due to vapor emissions can result if they are not properly handled and stored. All of the chlorofluoroalkanes purchased by Bayou Choctaw in 1987 were CFC-113. The supply of CFC-113 is stored indoors at the Warehouse until needed. During the Environmental Survey, chlorofluoroalkanes appeared to be stored properly at Bayou Choctaw.

8.2.2.2 Findings and Observations

8.2.2.2.1 Category I

None.

8.2.2.2.2 Category II

None.

8.2.2.2.3 Category III

1. Inadequate Secondary Containment Measures. There is a potential for releases of oil, chemical materials, and wastes into the environment from above-ground tanks and drum storage areas lacking effective spill containment. Drums containing chemical products and

waste materials are currently stored out-of-doors and unprotected at locations lacking impervious flooring and curbing to contain spills. In the event of a tank/drum leak or rupture, spilled substances would contaminate surrounding soils and could possibly be released into nearby surface waters. These deficiencies were identified during an EPA inspection of the Weeks Island site, the DOE Site Management Appraisal at the St. James Marine Terminal, and in an environmental audit of the Bayou Choctaw site conducted by BPS. Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous waste) above-ground tanks and drum storage areas, such measures are considered good management/operational practice.

Deficient storage of chemical products and wastes noted by the Environmental Survey Team include the following:

- The Drum Storage Area in the Laydown Yard at Bayou Choctaw is out-of-doors, lacks impervious flooring, and is not diked. About thirty-five 55-gallon drums of various chemicals and thirty 55-gallon drums of AFFF are stored in this area.
- The 5,000-gallon tank used to store slop oil at Bayou Choctaw is not diked.
- About sixty "excess," acid-filled, lead batteries are stored on the ground's surface about 10 feet from the freshwater marsh at Bayou Choctaw Cavern 10.
- The new Flammable Storage Building at Bayou Choctaw is not equipped with dikes or other means of spill containment at the doors. At the time of the on-site portion of the Environmental Survey, this building was not in use.
- Two 100-gallon-capacity, above-ground tanks that are used to store diesel fuel, one located at the flood pump structure and the other at the disposal wells, have not been provided with secondary containment dikes.

8.2.2.2.4 Category IV

None.

8.2.3 Radiation

8.2.3.1 Background Information

The regulations applicable to the radioactive sources used at Bayou Choctaw are summarized in Section 5.2.3.1.

8.2.3.2 General Description of Pollution Sources/Controls

There are 14 gamma-ray densitometers at the Bayou Choctaw site. The activities of these units range between 200 mCi and 500 mCi of cesium-137. The sources are required to be tested once every three years. The most recent leak test for 12 of the sources was in April 1987. Two of the sources were acquired in 1986 and were leak-tested by the vendor in September 1986. These two sources will not require another leak test until 1989. There were no leaks detected in the 1986 and 1987 tests.

There have been no well-logging sources lost at the Bayou Choctaw site.

There are no sulfur analyzers at Bayou Choctaw.

There are three tritium-lighted exit signs at Bayou Choctaw. Each sign contains 8.7 Ci of tritium. Possession of these signs does not require a license. There are no leak-test requirements for these signs.

8.2.3.3 Findings and Observations

8.2.3.3.1 Category I

None.

8.2.3.3.2 Category II

None.

8.2.3.3.3 Category III

None.

8.2.3.3.4 Category IV

None.

PRELIMINARY

8.2.4 Quality Assurance

8.2.4.1 General Description of Data Handling Procedures

The quality assurance aspects of the environmental monitoring program at the Bayou Choctaw site are governed by the BPS Environmental Programs and Procedures Manual (Teerling, 1986c). The requirements of the manual are summarized in Section 3.2.4.1. The environmental monitoring program at the Bayou Choctaw site includes required NPDES monitoring at twelve permitted discharge points. Although there are no regulatory requirements to do so, Bayou Choctaw conducts surface-water monitoring to assess the impact of the site operations on adjacent surface-water bodies. The water monitoring at Bayou Choctaw is discussed in more detail in Section 8.1.2.3.

The Bayou Choctaw laboratory conducts environmental analyses for the Bayou Choctaw, Weeks Island, and St. James Marine Terminal sites. During the on-site portion of the Survey, the Survey team toured the Bayou Choctaw laboratory and reviewed the laboratory's quality assurance records. Laboratory practices and records were observed to be consistent with the requirements of the BPS Environmental Programs and Procedures Manual (Teerling, 1986c).

The Survey team reviewed the 1987 internal quality control records for the laboratory. More than 95 percent of all analyses of spiked and duplicate samples met acceptance criteria. This indicates that laboratory precision and accuracy are acceptable.

The Survey team reviewed the performance of the Bayou Choctaw laboratory in the 1987 laboratory intercomparison programs, which were administered by BPS. During 1987, the laboratory's performance in the analysis of the BPS samples was within ± 1.5 standard deviations (based on the expected precision of the technique) of the known values for all parameters. This is generally considered to be acceptable performance.

Written sampling procedures have been prepared for Bayou Choctaw. During the on-site portion of the Survey, the Survey team observed sampling at one location. The sample collector carried the sampling logbook into the field and entered sampling information, while at the sampling point. The pH determination was made in the field using a wand-type pH meter. This pH meter was calibrated in the laboratory prior to field use. The Survey team did not observe any practices that would compromise the validity of the data.

The Survey team reviewed the sample custody log and copies of the custody forms for 1987. The log and forms were found to be up-to-date. Spot checks did not reveal any samples, that were sent to off-site laboratories, for which custody forms were not present.

8.2.4.2 Findings and Observations

8.2.4.2.1 Category I

None.

8.2.4.2.2 Category II

None.

8.2.4.2.3 Category III

None.

8.2.4.2.4 Category IV

None.

PRELIMINARY

8.2.5 Inactive Waste Sites and Releases

8.2.5.1 Background Information

The Survey team investigated each of the SPR facilities to identify inactive waste sites and releases of hazardous materials that are sources or potential sources of environmental contamination. Inactive sites and hazardous materials releases reviewed by the Environmental Survey team may either be subject to various environmental regulations or may not be addressed by the environmental regulatory framework. The Survey team identified and inventoried all inactive sites and hazardous materials releases that may cause environmental problems, regardless of the regulatory status of the sites or materials involved. Document reviews, personal interviews, and brief site visits were the basis for the observations and findings described in this section.

Many of the inactive waste sites and releases identified by the Survey team may be subject, via the Federal Facilities provision, to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and associated Executive Orders. Therefore, DOE Order 5480.14 (under revision) was issued on April 26, 1985 to implement DOE's CERCLA Program, which is intended to define actions for identification and evaluation of inactive hazardous waste sites on DOE installations and to effect remedial actions, where warranted. The first two phases of a five-phased program, prescribed under DOE Order 5480.14, were completed before the Survey team visited the SPR sites. A report was prepared under each of these two phases--the Phase I CERCLA Report: Installation Assessment, April 1986 (BPS, 1986b) and the Phase II CERCLA Report: Confirmation, April 1987 (BPS, 1987f). According to DOE 5480.14, Phase I was intended to "evaluate site history and records, and to locate and identify those inactive hazardous waste disposal sites that may pose a risk to health, safety and the environment as a result of migration of hazardous substances." Phase II was described by DOE 5480.14 as an effort to "quantify, by preliminary and comprehensive environmental survey, the presence or absence of hazardous substances that may pose a risk to health, safety, and the environment." The Survey team used the Phase I and II CERCLA Reports to aid in identifying and evaluating inactive waste sites and releases.

Since passage of the Superfund Amendments and Reauthorization Act (SARA) of 1986, DOE has revised its CERCLA program and DOE Order 5480.14 to implement the new SARA requirements. DOE has replaced the five-phased program and adopted the Environmental Protection Agency (EPA) program as outlined in the National Contingency Plan. DOE also issued guidance to its facilities on how to use data collected under its old CERCLA program to meet requirements of SARA. Conversion of Phase I CERCLA Reports (i.e., Installation Assessments) to Preliminary Assessments (i.e., the first step under the EPA program) was to be completed by April 1988.

This section summarizes the potential for uncontrolled spills of hazardous substances into the environment from inactive waste sites and spills at Bayou Choctaw. Information was obtained from SPR personnel and files as well as the Phase I and II CERCLA Reports (BPS, 1986b and 1987f).

8.2.5.2 General Description of Pollution Sources/Controls

During the DOE Environmental Survey, the team determined that drilling wastes and wastes from brine production have been disposed of on-site. These include drilling muds, salt cuttings, and anhydrite, which are all nonhazardous wastes. Some small oil and brine spills have also occurred on-site.

8.2.5.2.1 Past Activity

Activity on the Bayou Choctaw salt dome primarily consisted of oil, gas, and brine production and product storage. In 1930 and 1931, eight sulfur exploration wells were drilled, but no sulfur was found. Drilling for oil started in 1931. Since then, over 300 oil and gas wells have been drilled by various companies around the dome. Although production reached a plateau from the late 1930s through the early 1950s, some production is ongoing today (BPS, 1986b).

In 1934, Allied Chemical Corporation (formerly Solvay Process Company), purchased the property over the dome and commenced drilling for brine development. Since 1934, Allied has drilled over 20 brine wells on the dome (Acres, 1983). Allied's method of brine operation was for rapid extraction of brine with minimal attempt made to control the shape or size of the caverns. As a result, several of the caverns were solutioned to the caprock, resulting in leakage and ultimate abandonment. This uncontrolled brining method resulted in the collapse of the roof and overburden above Cavern 7 in January, 1954. The failure of this cavern resulted in a large area of ground subsidence, which was filled with water from Bayou Bourbeaux, and the formation of Cavern Lake (see Figure 8-4).

Generally, drilling muds and cuttings were disposed of in pits adjacent to the wells being drilled and covered in place after drilling operations were completed. Allied did not use heavy metals in drilling muds when brine and storage wells were drilled (BPS, 1986b).

Anhydrite, which is a residue of anhydrous calcium sulfate from brine production, was also disposed of on the ground in various locations on-site. According to site personnel, large quantities of anhydrite in rock form have been found during DOE construction activities (e.g., during excavations

at Well 17 and the warehouse). However, anhydrite disposal on-site has not occurred for many years. According to an employee of Union Texas, which was a wholly-owned subsidiary of Allied until 1985, anhydrite was not generated outside the caverns since at least the early 1970s, when he started working at Bayou Choctaw (Ross, 1988). The rate of brine production was slow enough that the anhydrite settled out in the caverns.

In 1976, DOE purchased part of the Bayou Choctaw salt dome from Allied Chemical Corporation for the SPR storage program. At the time of the acquisition, the site contained twelve caverns and three wells. Four caverns (Figure 8-7) were active; Caverns 18, 19, and 20 contained brine and Cavern 15 contained No. 2 diesel fuel. The other caverns were not suitable for use and are inactive today (Table 8-6). Since acquisition, DOE has drilled reentry wells at all four caverns and developed Cavern 102. Cavern 102 was then transferred to Allied in exchange for Cavern 17. Cavern 17 was used for brine storage until approximately 1968. Then, it was used for ethane storage until the exchange for Cavern 102 in 1985 (Ross, 1988). Caverns 15, 17, 18, 19, and 20 are used now only for crude-oil storage. In addition, a new cavern (No. 101) was being leached for crude-oil storage at the time of the DOE Environmental Survey. DOE also drilled twelve brine disposal wells south of the main site area. These wells are located on three wellpads (see Figure 8-5).

8.2.5.2.2 DOE Disposal of Drilling Muds and Cuttings

Drilling muds and cuttings generated during DOE operations were either disposed of off-site at commercial disposal facilities or at the mud disposal pit that SPR constructed just south of Brine Disposal Wellpad 1 (Figure 8-8). One of the off-site disposal facilities used is the Bayou Sorrel site, which is on the CERCLA National Priorities List. According to site personnel, this disposal site was used during 1978 and 1979, when the site was initially drilling reentry wells and brine disposal wells. The Reliable Production Services site, located in Livonia, Louisiana, was used later when wells were drilled at Caverns 17, 101, and 102. DOE also removed old muds and cuttings, which had been generated prior to DOE acquisition, from inactive pits located near Caverns 18, 19, and 20 in order to expand the pads and to drill reentry wells. These muds and cuttings were taken to the mud disposal pit (BPS, 1986b). Muds and cuttings that would not interfere with expansion projects (i.e., muds and cuttings near Cavern 15) were not removed from inactive pits. Muds and cuttings from the wells at Brine Disposal Wellpad 1 are also thought to have been disposed of in the mud disposal pit (BPS, 1986b). Muds and cuttings from the wells at Brine Disposal Wellpads 2 and 3 were originally disposed of near the wells, but were later removed by DOE and disposed of at the mud disposal pit. Muds and cuttings disposed of at this pit were cement-stabilized.

FIGURE 8-7

INACTIVE WASTE DISPOSAL SITES AT BAYOU CHOCTAW STRATEGIC PETROLEUM RESERVE

TABLE 8-6

INACTIVE CAVERN AND ABANDONED WELLS ON DOE PROPERTY
BAYOU CHOCTAW SITE
STRATEGIC PETROLEUM RESERVE

Cavern or Well No.	Date Drilled	Initial Drilled Depth (feet)	Depth to top of Cavern feet (Date)	Gross Volume 10% bbbl* (Date)	Status	Remarks
1	1937	1,988	950 (1977)	8.42 (1977)	Idle	Not pressure tight due to leak in casing; not repairable.
2	1934	1,846	715 (1977)	9.02 (1977)	Idle	Thin salt roof and poor quality caprock.
3	1934	2,000	890 (1977)	5.01 (1977)	Idle	Pressure communication with Caverns 11 and 13, and with Cavern 4 at higher pressure.
4	1935	1,990	620 (1980)	5.94 (1980)	Abandoned	Leached into caprock. In communication with freshwater aquifers. <u>Permanent facilities sited within possible zone of cavern failure.</u>
5	1943	775	--	--	Abandoned	Cavern never completed because of local subsidence.
8A	1944	2,007	1,235 (1980)	3.12 (1980)	Idle	Not pressure tight due to leak in casing. Replacement for Well No. 8, which was abandoned due to local subsidence.
9	1944	2,013	--	--	Abandoned	Casing collapsed due to local subsidence. No cavern developed.
10	1947	1,942	990 (1973)	6.4 (1973)	Idle	Not pressure tight. Cavern may have been leached through the salt to the surrounding sediments, or the casing seat may be leaking.
11	1947	1,928	1,030 (1978)	9.5 (1978)	Idle	See No. 3. Operated with No. 13 in 1972. Sonar volume in 1972 was 10.5% TOP bbl.
12	1947	2,020	--	--	Abandoned	Well collapsed due to local subsidence. No cavern brined.
13	1948	1,915	1,103 (1977)	4.31 (1977)	Idle	See No. 3. Operated with No. 11 in 1972.

Sources: DOE Environmental Survey team, 1988. Adapted from Acres, 1983, and Linn, 1986.

*bbl = barrels; 1 barrel equals 42 gallons.

NOT TO SCALE

Source: BPS, 1987f.

FIGURE 8-8

DISPOSAL AREAS SOUTH OF BRINE DISPOSAL WELLPAD 1 AT BAYOU CHOCTAW
STRATEGIC PETROLEUM RESERVE

Anhydrite boulders found during excavation were disposed of near the mud disposal pit (Figure 8-8). Some anhydrite was also used as fill at Cavern Pad 101. In addition, synthetic lining material used in the brine pond and miscellaneous items were disposed of at the disposal area near the mud disposal pit.

SPR was concerned that some drilling muds disposed of at the mud disposal pit could be contaminated with heavy metals, including chromium from mud additives. Some muds used contained a chrome lignosulfonate mud additive (e.g., muds for Well 102 and Brine Disposal Well 1; BPS, 1986b). Muds used in drilling Well 102 were disposed of off-site at the Reliable Production Services facility, but muds for Brine Disposal Well 1 could have been disposed of in the mud disposal pit. Typical chrome lignosulfonates contain approximately 3 percent chromium by weight. Chromium is a hazardous substance and a constituent of EP (extraction procedure) toxicity (EPA hazardous waste number D007). A waste is considered hazardous if the extract contains over 5 mg/L of chromium in the hexavalent state. However, SPR found that extracts from samples were below 5 mg/L (BPS, 1987f). Ten samples were taken and none of the EP metals approached the regulatory thresholds. None of the organic EP toxicity constituents were detected. In addition, typical flora and fauna were found at the disposal area. Animal tracks, lush vegetation, and a variety of aquatic organisms were observed in and around standing water. No indications of plant stress were seen. Similar observations were made in the area where known mud pits were formerly located.

When the Cavern 17 pad was expanded, the old drilling muds and salt cuttings were removed and disposed of as fill in a low, wet area, which was located between the Control Building and the High Pressure Pump Pad (see Figure 8-7). Records indicate that a decision was made by the SPR to close this disposal area in conformity with Statewide Order 29-B, despite prior conflicting interpretations of the applicability of these regulations (Smith, 1986). Because mud characteristics (i.e., electrical conductivity, sodium adsorption ratio, and exchangeable sodium percentage) exceeded limits for simple disposal, the muds and cuttings needed to be mixed with soil and treated with gypsum or lime to meet land treatment requirements for closure. However, the wastes were not adequately treated and covered with additional fill. Since the initial disposal action, at least one attempt to treat the waste was made, however, Order 29-B specifications were not successfully met. Analytical results of the waste material, sampled in March 1987 after the treatment attempt, are shown on the next page and compared with Order 29-B land treatment limitations (WHA, undated). A limestone covering has since been added. Also, a parking lot was developed in this area.

	Electrical Conductivity (μ mhos/cm)	Sodium Adsorption Ratio	Exchangeable Sodium Percentage
Composite Waste Sample	22	29	24
Order 29-B Land Treatment Limitations	8	14	25

There is a potential for adverse environmental impact from this mud/cuttings disposal because of the lack of adequate treatment and use of the waste as fill material in a low-lying wet area. However, the magnitude of the impacts is uncertain. From a regulatory standpoint, SPR may still be required to close the disposal area in accordance with Statewide Order 29-B, by providing further treatment of the waste or disposal of the waste at an approved off-site facility. To be in compliance, SPR needs to close the site pursuant to Order 29-B by January 20, 1989 (i.e., the regulatory deadline). None of the other mud and cuttings disposal sites on DOE property, including the mud disposal pit located south of Brine Disposal Wellpad 1, needed to be closed pursuant to Order 29-B. These sites were closed before the Order became effective on January 20, 1986.

8.2.5.2.3 Inactive Caverns and Abandoned Wells

There are eight inactive caverns and three abandoned wells at the Bayou Choctaw DOE property. Information on these caverns and wells are presented in Table 8-6. At one time, Cavern 10 (see Figure 8-7) was thought to be contaminated with hazardous material and a possible source of off-site contamination. The potential for contamination from this and other inactive caverns are discussed below. Active caverns that are used to store crude oil should not be a source of contamination; these caverns are considered stable and pressure-tight (Acres, 1983).

During replacement of a wellhead pressure gauge at Cavern 10, a caustic solution was discovered in the well casing string. Subsequent discussions with Allied revealed that they had disposed of approximately 300 barrels (12,600 gallons) of a potassium hydroxide solution into the cavern (BPS, 1986b). As part of DOE's RCRA program (Phase 2), SPR took a sample from the wellhead and analyzed for pH, sodium, chloride, potassium, and EP toxicity in November, 1986 (BPS, 1987f). The pH was 13.7, which indicated that the sample was a corrosive hazardous waste (Hazardous Waste Number D002). The sample extract also contained 89.4 mg/L of lead. Because this concentration exceeded the toxicity regulatory threshold for lead of 5 mg/L, the cavern solution also appeared to be EP toxic (Hazardous Waste Number D008). The source of lead is uncertain, but is thought by some SPR employees to have been pipe dope or the well seal. However, it was recognized that the sample analyzed was not representative of the solution in the cavern (BPS, 1987f); there was an obstruction

in the casing, which SPR believes to be a potassium hydroxide plug (Hartley, 1988b). The sample, therefore, represented only a small volume of liquid in the casing. A year later, additional sampling of Cavern 10 was conducted as part of a SPR plugging and abandonment program. For this sampling, the obstruction was removed and representative samples of the cavern solution were collected. Draft analytical results indicate that the cavern solution is not hazardous (Upton, 1988b). The pH levels of the samples were below the hazardous level of 12.5. Lead was measured at 1.4 mg/L at the shallowest depth (450 feet) and was not detected at the deeper depths (below the casing string).

Solutions in the other inactive caverns should also be nonhazardous. Allied indicated that these caverns were not used for disposal of any wastes, although documentation of all cavern uses was not available to the Survey team. DOE has never used these caverns for the injection or disposal of wastes (BPS, 1986b). Analysis of samples taken in October and November, 1987 from Cavern 1, 2, 3, 8A, and 13 did not reveal any hazardous characteristics (Upton, 1988a). Cavern 4 and Wells 4, 5, 8, 9, 11, and 12 have not been sampled; Wells 4, 5, and 9 are located under water most of the time, Well 8 is covered by a metal plate, Well 11 is plugged, and Well 12 may be plugged (Hartley, 1988b). Analysis of samples taken from two on-site coreholes into the salt also did not reveal any hazardous characteristics.

8.2.5.2.4 Spills

Spills of oil and brine have occurred on-site, both prior to the DOE property acquisition and after. In addition, small quantities of acid have been spilled during acidizing operations at the brine disposal wells. These spills appeared to have been controlled and cleaned up where practicable. No adverse impacts from oil and brine spills were noted by the DOE Environmental Survey team.

In 1987, the two lines from the brine pond to the low pressure brine pump pad sump leaked. The leaks in the lines were repaired, but at the time of the Survey, they were leaking where the lines meet the walls of the pump pad sump. The shallow groundwater in the area was being pumped to collect the brine; the groundwater was being discharged to the brine pond, at a rate of approximately 7,200 gallons per day, until the leaks could be repaired. In a spill incident report, the SPR environmental specialist noted that salinity in the adjacent ditch and the east-west canal were unaffected by the leak and remained at 4-5.5 ppt, which is normal for low water levels in the canal (Russell, 1987).

Based on a review of SPR spill incident reports, the Survey team found that, during 1987, there were 16 small spills of brine, diesel fuel and oil (<1 barrel), and one large brine spill (150 barrels). This

latter brine spill occurred on October 9, 1987, at Brine Disposal Wellpad 3, when a line from a frac-tank ruptured. Recovery of the brine was not feasible, and the spill could have caused some temporary shallow groundwater contamination. The dike around the wellpad prevented lateral migration into the surrounding wetlands/surface water, but some downward migration through the wellpad material and near-surface clay could have occurred. However, no aquifer used as a drinking water source could have been contaminated. A thick layer of clay overlies the area's drinking water aquifer (refer to Section 8.1.3.1.2) and would have prevented migration into this aquifer. Thirteen small spills occurred during 1986; one was an 18-gallon spill of the herbicide Wipe-Out. During 1985, two large oil spills (250 barrels and 25 barrels) occurred on the Cavern 101 pad. Both spills were contained by the pad levee and the oil was recovered. In addition, there were eight other small spills on site. No visual indications of any lasting significant impacts from any of the spills were observed by the Environmental Survey team.

8.2.5.3 Findings and Observations

8.2.5.3.1 Category I

None.

8.2.5.3.2 Category II

None.

8.2.5.3.3 Category III

1. Inadequate Closure of Drilling Spoils Disposal Area. A low, wet area that was located in between the Control Building and the High-Pressure Pump Pad at Bayou Choctaw (Figure 8-7) was used for disposal of waste drilling muds and salt cuttings and was not closed in compliance with specifications set forth in Statewide Order No. 29-B. Due to inadequate treatment of the waste and its disposal in a low-lying wet area, there is a potential for some waste constituents to migrate from the immediate area and adversely impact the surrounding environment.

Drilling muds and salt cuttings (i.e., nonhazardous oilfield waste) generated during drilling of Cavern 17 well were removed from an old, closed pit near the well and disposed of as fill in a low-lying wet area. The waste was removed from the old pit, when the Cavern 17 pad was expanded; this was necessary to have the expanded pad meet compaction specifications.

Records indicate that a decision was made by the SPR to close the new disposal area in conformity with Order 29-B, despite prior conflicting interpretations of the applicability of these regulations (Smith, 1986). Because mud characteristics (i.e., electrical conductivity, sodium adsorption ratio, and exchangeable sodium percentage) exceeded limits for simple disposal, the muds and cuttings needed to be mixed with soil and treated with gypsum or lime to meet land treatment requirements for closure. However, an initial treatment was insufficient to meet those requirements, as evidenced by chemical analyses. Since the initial disposal action, at least one attempt to re-treat the waste was made; however, Order 29-B specifications still were not successfully met. Analytical results of the waste material, sampled in March 1987 after the treatment attempt, are shown below and compared with Order 29-B land treatment limitations (WHA, undated). A limestone covering has since been added. Also, a parking lot was developed in this area.

	Electrical Conductivity (umhos/cm)	Sodium Adsorption Ratio	Exchangeable Sodium Percentage
Composite Waste Sample	22	29	24
Order 29-B Land Treatment Limitations	8	14	25

There is a potential for adverse environmental impacts from this mud/cuttings disposal because of the lack of adequate treatment and use of the waste as fill material in a low-lying wet area. However, the magnitude of the impacts is uncertain. From a regulatory standpoint, SPR may still be required to close the disposal area in accordance with Statewide Order 29-B, by providing further treatment of the waste or disposal of the waste at an approved off-site facility. To be in compliance, SPR needs to close the site pursuant to Order 29-B by January 20, 1989.

8.2.5.3.4 Category IV

None.

9.0 ST. JAMES TERMINAL

The DOE-owned St. James Terminal is located in St. James Parish, Louisiana, about 45 miles southeast of Baton Rouge, on the Mississippi River (Figure 9-1). The area around the St. James Terminal site is rural in nature. The terminal is bounded by the Texas and Pacific Railroad to the west, commercial terminal facilities to the north and south, and the Mississippi River levee on the east. The area adjacent to the Mississippi River at the St. James docks is a freshwater wetland. Much of the land area surrounding the terminal is used for pasture and sugar cane cultivation.

The site was acquired in 1978 and construction of the terminal was completed in early FY 1981. The terminal serves the Weeks Island and Bayou Choctaw SPR storage sites (Capline group) for oil fill and drawdown. The terminal has two tanker docks for delivery and pickup of crude oil as well as six surge tanks totaling 2 million barrels of capacity. The terminal is also directly connected via pipeline to the adjacent LOCAP commercial terminal and has, under construction, a pipeline connection to the Capline commercial terminal.

9.1 Media-Specific Survey Findings

The discussions in this section pertain to existing or potential environmental problems in the air, surface water, and groundwater/soil media. The discussions include a summary of the available background environmental information related to each medium, a description of the sources of pollution and their control techniques, a review of the environmental monitoring program specific to each medium, and a categorization and explanation of the environmental problems found by the Survey team related to each medium.

9.1.1 Air

9.1.1.1 Background Environmental Information

The air portion of the Environmental Survey of the St. James Marine Terminal is designed to address existing and potential environmental impacts associated with releases of contaminants to the atmosphere. This portion includes a critical evaluation of air pollution sources and controls as well as compliance with air pollution regulations. Adherence to established environmental procedures is evaluated from the standpoint of environmental problems or risks. Principal regulations relating to air emissions used as guidance during the Survey include the following:

FIGURE 9-1

ST. JAMES, LOUISIANA, MARINE TERMINAL LOCATION STRATEGIC PETROLEUM RESERVE

- The Clean Air Act (CAA) and amendments.
- Federal regulations, including
 - National Ambient Air Quality Standards (NAAQS) (40 CFR 50).
 - Standards of Performance for New Stationary sources (40 CFR 60).
 - National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61).
- Louisiana Air Quality Regulations.

The St. James Terminal is located in St. James Parish, Louisiana, which is included in the Southern Louisiana-Southeast Texas Interstate Air Quality Control Region (AQCR) No. 106 (40 CFR 81.53, July 1, 1987).

The national ambient air quality standards (see Table 3-1) have been incorporated into Louisiana air pollution control regulations, which are enforced throughout the state. The attainment status of AQCR No. 106 is described (40 CFR 81.319, July 1, 1987) as follows:

Parameter	Status
Total Suspended Particulates	Better than National Standards
Sulfur Dioxide	Better than National Standards
Ozone	Does not meet Primary Standards
Carbon Monoxide	Cannot be Classified or Better than National Standards
Nitrogen Dioxide	Cannot be Classified or Better than National Standards

The status of other criteria pollutants, including PM-10 particulate matter and lead, has not been published.

Wind data recorded at the New Orleans International Airport, which is about 30 miles east of the St. James Terminal, are representative of air-flow patterns along that section of the Gulf Coast. Characteristic wind patterns for stations near the SPR sites are discussed in Section 2.1.

9.1.1.2 General Description of Pollution Sources/Controls

A Certificate of Approval for Air Emissions at St. James Terminal (Permit No. 983) was issued by the Louisiana Air Control Commission on July 25, 1978 (LACC, 1978c). The Permit limits VOC emissions during loading and unloading operations as shown in Table 9-1.

TABLE 9-1

VOC EMISSION LIMITS IN PERMIT FOR ST. JAMES MARINE TERMINAL
STRATEGIC PETROLEUM RESERVE

Source	VOC Emission Limits, lb/hr	
	Unloading ⁽¹⁾	Loading ⁽²⁾
1-78 Surge Tank (200,000 bbl)	1.42	3.442
2-78 Surge Tank (200,000 bbl)	1.42	2.210
3-78 Surge Tank (400,000 bbl)	1.993	4.831
4-78 Surge Tank (400,000 bbl)	1.993	4.831
5-78 Surge Tank (400,000 bbl)	0.0	3.102
6-78 Surge Tank (400,000 bbl)	0.0	3.102
7-78 Tanker	332.64	798.7
8-78 Tanker	332.64	798.7
Pump Seals	0.377	0.753
Valve Stems	0.225	0.450

Source: LACC, 1978c.

- (1) Transfer from tanker holds through surge tanks to distribution pipelines.
 (2) Transfer from distribution pipelines through surge tanks to tanker holds.

Specific sources of VOC emissions included in the Permit (Figure 9-2) are four 400,000-barrel surge tanks, two 200,000-barrel surge tanks, two tanker docks, pump seals, and valve stems.

Because the St. James Terminal is located in an ozone nonattainment area and VOC emissions can contribute to ozone formation in the atmosphere, it was necessary that the facility either (1) meet EPA emissions offset policy requirements or (2) obtain an exemption from the EPA. An exemption was provided by EPA on the basis that the SPR project was markedly different from other crude-oil handling facilities because movement of oil through the terminal would not be a routine operation (Barber, 1977).

In addition to the VOC sources specifically included in the Permit, St. James Terminal has four slop-oil tanks and a diesel-powered fire-water pump.

9.1.1.2.1 Surge Tanks

The six surge tanks are to be used during fill and withdrawal of crude oil at the Weeks Island and Bayou Choctaw SPR facilities. The unequal, random, and frequent arrivals of tankers at the two docks require the use of the six tanks to allow uninterrupted oil flow to or from Weeks Island or Bayou Choctaw. Emissions of VOCs from the crude oil to the atmosphere are possible in normal operation of the tanks. The tanks come under the requirements of Standards of Performance for New Stationary Sources, specifically Subpart K - Standards of Performance for Storage Vessels for Petroleum Liquids Constructed After June 11, 1973, and Prior to May 19, 1978 (40 CFR 60). This is because they are larger than 65,000 gallons (1,550 barrels), they are used to store petroleum liquids, and construction started on January 19, 1978. Because the true vapor pressure of the crude oil falls in the range of 1.5 pounds per square inch absolute (psia) and 11.1 psia, Subpart K requires the tanks to have either floating roofs, vapor recovery systems, or the equivalent. Thus, the tanks are fitted with external floating roofs with primary metallic shoe seals and secondary rim-mounted seals to minimize emissions of VOCs to the atmosphere.

The surge tank seals were inspected by the tank vendor in 1983 and 1987. The 1983 inspection found the seals to be in good condition. The 1987 seal inspection, initiated by BPS, showed that the seals had deteriorated and were in need of repair or replacement (PCA, 1987). A contract was let to replace seals on two tanks (No. 1 and No. 2) and to make repairs to others. Work on Tank No. 2 was nearing completion at the time of the on-site Survey. Work on all six tank seals was to be completed by the end of calendar year 1989.

Source: Adapted by DOE Environmental Survey Team from BPS, 1987h

FIGURE 9-2

LOCATION OF PERMITTED AIR-EMISSION SOURCES AT ST. JAMES TERMINAL STRATEGIC PETROLEUM RESERVE

9.1.1.2.2 Tanker Docks

VOC emissions occur from tanker ship holds at the river docks. When tankers are loaded with crude oil from the surge tanks, VOCs released within the hold will be displaced by the incoming crude oil. However, these VOC releases are likely to be minimal because most of the oil stored at Weeks Island and Bayou Choctaw would be distributed via pipeline through commercial terminals adjacent to St. James Terminal, rather than by tanker. Secondly, as crude oil is transferred from the tanker to the surge tanks, it has been necessary to place water in the empty hold as ballast. The water then displaces any VOCs that remain in the hold. VOC releases during tanker unloading have largely ended because Weeks Island and Bayou Choctaw SPR caverns are nearly filled and because of the use of segregated and clean ballast ships exclusively. Otherwise, emissions from tanker holds are uncontrolled.

9.1.1.2.3 Valve Stems and Pump Seals

VOC emissions are possible, if valve stems and pump seals leak. These potential sources are recognized in the Permit and VOC emission rates are calculated. The Permit does not specify any preventive maintenance procedures.

9.1.1.2.4 Space Heating

Space heating at St. James is provided by electricity.

9.1.1.3 Environmental Monitoring

9.1.1.3.1 Monitoring of Ambient Air Quality

A monitoring program was initiated by the site contractor at St. James Terminal on October 1, 1982 to determine baseline ambient air-quality. The program continued through September 30, 1983 (York, 1984). Parameters monitored during that period were total suspended particulates, ozone, and nonmethane hydrocarbons (volatile organic compounds). The total suspended particulates met both primary and secondary annual and 24-hour standards, while ozone exceeded the hourly standard (which is not uncommon in an AQCR designated as a nonattainment area for ozone). Although there are no current air-quality standards for nonmethane hydrocarbons, the maximum hourly value was 5.35 ppm (York, 1984). There are no regulatory requirements for continued air-quality monitoring.

9.1.1.3.2 Emission Monitoring

As required by the Louisiana Environmental Control Commission (Regulation 12.17), a revised Emission Inventory Questionnaire (EIQ) was prepared June 1, 1983, that included estimates of VOC emissions based on then current equations and emission factors published by the EPA as well as site performance data for the periods 1980, 1981, and 1982. These revised emission rates, which are shown in Table 9-2, are both emission estimates and new limits.

9.1.1.4 Findings and Observations

9.1.1.4.1 Category I

None.

9.1.1.4.2 Category II

None.

9.1.1.4.3 Category III

1. Volatile Organic Compound Emissions from Crude-Oil Surge Tanks. Gaps existing in tank roof seals allow excessive emissions of VOCs to the atmosphere from St. James Terminal crude-oil surge tanks.

VOCs can react photochemically in the atmosphere to form ozone, a criteria pollutant that is harmful to human health. The Interstate AQCR, in which St. James is located, is classified by the EPA as a nonattainment area for ozone.

Six surge tanks (four 400,000-barrel and two 200,000-barrel) were constructed at the DOE St. James Terminal, beginning in January 1978. Each tank was equipped with an external floating roof that consists of a pontoon-type cover resting on the crude-oil surface. A closure device consisting of a metallic-shoe seal (primary seal) and another seal (secondary seal), mounted above the primary seal, was installed between the roof edge and the tank wall to control VOC emissions. A BPS-initiated inspection of those seals by a contractor on May 19, 1987, revealed substantial gaps between the seals and the tank walls, which are open pathways for the escape of VOCs to the atmosphere.

TABLE 9-2

**ESTIMATED VOC EMISSIONS PER EIQ FOR ST. JAMES MARINE TERMINAL
STRATEGIC PETROLEUM RESERVE**

Source	Maximum VOC Emission Estimates, lb/hr	
	Unloading ⁽¹⁾	Loading ⁽²⁾
1-78 Surge Tank (200,000 bbl)	4.181	4.044
2-78 Surge Tank (200,000 bbl)	4.181	4.044
3-78 Surge Tank (400,000 bbl)	3.007	2.995
4-78 Surge Tank (400,000 bbl)	3.007	2.995
5-78 Surge Tank (400,000 bbl)	3.007	2.995
6-78 Surge Tank (400,000 bbl)	3.007	2.995
7-78 Tanker	652.680	278.484
8-78 Tanker	652.680	278.484
Pump Seals	0.377	0.188
Valve Stems	0.288	0.234

Source: Gilman, 1983.

- (1) Transfer from tanker holds through surge tanks to distribution pipelines.
 (2) Transfer from distribution pipelines through surge tanks to tanker holds.

The deficiencies have been recognized by site management and remedial action was in progress at the time of the on-site Survey to return the seals to design specifications. Rehabilitation of Tank No. 2 was near completion. Similar repairs are scheduled to be completed on the remaining five tanks by October 1989.

9.1.1.4.4 Category IV

None.

PRELIMINARY

9.1.2 Surface Water

9.1.2.1 Background Environmental Information

9.1.2.1.1 Surface-Water Bodies in the Area

The major surface-water body at St. James Terminal is the Mississippi River, on whose banks the terminal's loading docks are located. The main portion of the site is just a few hundred yards west of the river. The St. James Canal, which flows into Bayou Citamon, is to the west of the site (Figure 9-3).

9.1.2.1.2 Sources of Water Used at the Site

Fire protection water comes from pumps located on Dock No. 1 on the Mississippi River. All other water use at the site is supplied from the St. James Parish water distribution system (Chatelain and Roberts, 1987). This includes a tie-in of the water distribution system to the storage tank being installed as part of the fire protection system upgrade project, which was being established at the time of the on-site Survey.

9.1.2.1.3 Flood Plain

The terminal is within the flood plain of the Mississippi River. The flood protection levee adjacent to the site has a crest elevation of 22.5 feet. Site grade elevation is approximately 11.5 to 14.5 feet.

9.1.2.2 Description of Pollution Sources/Controls

9.1.2.2.1 Water Uses at the Site

The only water uses at St. James Terminal are for drinking, sinks, hose connections, toilet flushing, and fire protection. The fire protection water is supplied by pumps located at Dock No. 1 on the Mississippi River. The fire protection system at St. James Terminal, as is done at other SPR sites, uses Aqueous Film Forming Foam (AFFF) in order to improve the fire extinguishing capabilities of the system. This material is effective in covering and extinguishing hydrocarbon liquid-based fires. AFFF is obtained from a variety of suppliers through competitive bids. However, all the materials have similar characteristics of high biochemical and chemical oxygen demand (BOD and COD); are mostly biodegradable; contain 5 percent or less fluorocarbon surfactants, which are not biodegradable; and exhibit varying degrees of aquatic toxicity, although they are classified as practically nontoxic in

Source: USGS, 1962.

FIGURE 9-3

SURFACE WATERS IN THE VICINITY OF ST. JAMES TERMINAL STRATEGIC PETROLEUM RESERVE

the manufacturer's literature because the oral LD₅₀ for rats is greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered.) The oxygen depletion due to the high BOD and COD, coupled with the aquatic toxicity, could result in short-term environmental degradation if this material is released to adjacent surface water. The as-purchased concentrate is mixed with water to provide a 3-percent solution to be sprayed on the fire. Automatic foam proportioning equipment is available at the docks as well as in the main site area. The mobile fire fighting equipment is also capable of using AFFF. SPR procedures call for annual testing of the fire protection systems and training of personnel. SPR has estimated that 21,600 gallons of 3 percent AFFF solution would be generated annually in training and testing exercises at St. James Terminal. Because the AFFF is mostly biodegradable, the sewage treatment plants could treat the waste; however, the annual capacity of the existing systems for treating AFFF is only 912 gallons. In addition, while the dikes at the oil surge tanks would contain foam used in fire-fighting or training exercises at those locations, there is no collection system in place at the site. SPR has temporarily suspended testing and training requirements until the disposal problem has been resolved. At the time of the on-site portion of the Survey, SPR was continuing dialog with the state and investigating disposal options. Subsequent to the on-site portion of the Survey, the Louisiana Department of Natural Resources granted permission for the disposal of AFFF into SPR's saltwater disposal wells (Welsh, 1988). A finding relating to disposal of spent AFFF is presented in Section 9.1.2.4.3. Fire protection water is also piped into a header (on each oil surge tank), which is used to spray water on the exterior of the tanks to keep them cool, if a fire occurs. AFFF is not used in this spray water.

At the time of the on-site Survey, the fire protection system was being upgraded. This upgrade includes provisions to supply city water to the fire protection system. The line from the potable water system enters the new water storage tank through the roof at least 8 to 10 inches above the overflow on the side of the tank, thus satisfying state requirements for an air gap between potable and non-potable water systems. The other water uses at St. James Terminal (such as drinking, toilet flushing, sinks, and washdown hose connections) are supplied by the city water system.

9.1.2.2.2 Brine Disposal

Unlike the other SPR sites, there is no brine generated or disposed of at the St. James Terminal because it is solely used to transfer oil between ships and the oil pipelines.

9.1.2.2.3 Sanitary Sewage

There are two extended aeration, activated sludge, package sewage treatment plants for treating the sanitary wastes at St. James Terminal. Both are rated at 1,500 gpd and are located adjacent to each other by the guard house. Sewage flow from the main site laboratory, shops, and offices averages 1,125 gpd. This sewage flows by gravity to a lift station, which then pumps it to the treatment plant. The 500-gpd average flow, from the guard house and temporary trailers to the other unit, is by gravity. Treated effluents from both units enter a common lift station, which pumps the discharge into the 20-inch line carrying all site NPDES permitted waste waters to the discharge point at Dock No. 1.

9.1.2.2.4 Storm Water

Storm water, from those areas on-site that are not likely to have oil spills, drains by gravity through a series of on-site and off-site ditches to the St. James Canal. Storm runoff from other areas at the main site (i.e., tank dikes, pump pads, meter pads, etc.) and the docks, which may become contaminated with oil in the event of a spill or leak, are passed through the oil/water separators and retention pond before being pumped to the Mississippi River. The two docks on the Mississippi River are curbed so that any oil spills, leaks, or contaminated storm-water runoff cannot enter the river directly. Sumps on the docks collect the runoff and pump it to the main site. The water from the docks first passes through an oil stop valve, which will route the flow directly to the slop-oil sump if it consists mostly of oil. Otherwise, the flow goes to an oil/water separator. The oil separated here is sent to the slop-oil sump and the water goes to a lift station, which collects the runoff waters from the main site area. The lift station pumps the combined water to either one or both of two additional oil/water separators. The separated oil from these separators also flows to the slop-oil sump, while the water flows into the retention pond. The retention pond has an oil boom at the inlet end to remove any oil that remains for transfer to the slop-oil sump. Ultraviolet light oil detection devices are installed at both the inlet and the outlet of the retention pond. These alert the control room operator, so that remedial action can be taken if oil is present. The retention pond is operated in a batch mode, that is, flow through it is not continuous. The water in the retention pond is tested to make certain that it meets the discharge limits (see Section 9.1.2.3 1) before the pumps are turned on to send it through the 20-inch line that discharges to the river at Dock No. 1. The oils that go to the slop-oil sump are pumped to Tank No. 1, where they become mixed with the oils being transferred off-site.

9.1.2.3 Environmental Monitoring Program

9.1.2.3.1 NPDES Monitoring

The surface water discharges at the St. James Terminal are regulated by National Pollutant Discharge Elimination System (NPDES) Permit LA0054674, issued by the U.S. Environmental Protection Agency (EPA) on July 12, 1985 and by Water Discharge Permit WP0929, issued by the Louisiana Department of Environmental Quality (LDEQ) on September 26, 1984. The NPDES permit has an expiration date of July 11, 1990, but there is no expiration date listed on the state permit. The only difference in the two permits is that mass loading limits for biochemical oxygen demand (BOD) and total suspended solids (TSS) at the sewage treatment plant discharges are included in the NPDES permit, and not in the state permit.

The locations of the three permitted discharge sampling points are shown in Figure 9-4. Although all three discharge through the same line to the Mississippi River, they are sampled at separate locations at the main site. Outfall 001 is the discharge from the storm-water runoff retention pond, while Outfalls 002 and 003 are the discharges from the sewage treatment plants serving the office building and the guard house areas, respectively.

Table 9-3 contains a list of the parameters measured, their limits, and the sampling frequency for the outfalls at St. James. The only noncompliance in 1986 was a BOD-level of 53 mg/L at the office area sewage treatment plant, which exceeded the permit limit of 45 mg/L.

9.1.2.3.2 Surface Water Monitoring

Off-site surface-water monitoring is not done at the St. James Terminal, primarily because the site is not contiguous with a water course or body of water other than the Mississippi River. Monitoring of the Mississippi River would not produce meaningful data attributable to the SPR due to its large flow and the large number of industrial and municipal discharges immediately upriver.

9.1.2.4 Findings and Observations

9.1.2.4.1 Category I

None.

TABLE 9-3

**DISCHARGE MONITORING REQUIREMENTS AND EFFLUENT LIMITATIONS
ST. JAMES TERMINAL SITE
STRATEGIC PETROLEUM RESERVE**

Outfall	Parameter	Minimum	Daily Average	Daily Maximum	Measurement Frequency	Sample Type
001 Storm-water Runoff	Flow	N/A	Report	Report	1/day ⁽¹⁾	Estimate
	Total Organic Carbon	N/A	Report	50 mg/L	1/day ⁽¹⁾	Grab
	Oil and Grease	N/A	Report	15 mg/L	1/day ⁽¹⁾	Grab
	pH	6.0 SU	N/A	9.0 SU	1/day ⁽¹⁾	Grab
002 & 003 Sewage Treatment Discharges	Flow	N/A	Report	Report	1/month	Estimate
	Biochemical Oxygen Demand	N/A	Report	45 mg/L 0.56 lbs/day ⁽⁴⁾	1/quarter ⁽²⁾	Grab
	Total Suspended Solids	N/A	Report	45 mg/L 0.56 lbs/day ⁽⁴⁾	1/quarter ⁽²⁾	Grab
	pH	6.0 SU	N/A	9.0 SU	1/quarter ⁽³⁾	Grab

Source: NPDES Permit LA0054674 and LDEQ Permit WP0929

(1) When discharging.

(2) If the value of this effluent characteristic exceeds the quarterly maximum limit in any sample, then the monitoring frequency for the State permit shall increase to 1/month. This increased frequency shall continue until a sample demonstrates a value less than or equal to 30 mg/L.

(3) Monitoring for pH shall increase to 1/month, if a sample demonstrates a value outside the 6 - 9 range. This increased frequency shall continue until a sample exhibits a value within the 6 - 9 range.

(4) Mass loading limit is only included in the EPA permit.

9.1.2.4.2 Category II

None.

9.1.2.4.3 Category III

1. Potential Oxygen Depletion of Nearby Surface Water From the Discharge of Aqueous Film Forming Foam (AFFF). AFFF is used throughout the SPR, because it is effective in covering and thus extinguishing hydrocarbon liquid-based fires. The release of untreated AFFF into surface water can have an adverse impact on surrounding wetlands. Although the materials available at the SPR sites will vary slightly in composition, they are characteristically classified by the manufacturers as being biodegradable and practically non-toxic, having an LD₅₀ of greater than 5 g/kg. (LD₅₀ is that dose of a material that will result in the death of 50 percent of the test specimens to which it is administered) These materials also contain fluorocarbon surfactants (5 percent or less) that are not biodegradable. AFFF materials exhibit varying degrees of aquatic toxicity and have a high biochemical oxygen demand (BOD) and chemical oxygen demand (COD). Therefore, AFFF (if discharged to adjacent surface water) could result in temporary oxygen depletion in those waters, in addition to being toxic to some aquatic species. Although there is no restriction on its use in emergency situations, state regulatory agencies require that it be treated prior to discharge when used in training or performance tests. This creates a disposal problem. Under optimum conditions, sewage treatment plants of the types installed at the SPR sites can effectively treat waste AFFF material; however, 21,600 gallons of waste AFFF are expected to be generated annually during training exercises and performance tests at St. James Terminal. The treatment plant could handle only an estimated 912 gallons per year. Subsequent to the on-site portion of the Survey, permission was received from the state to dispose of AFFF into SPR's saltwater disposal wells (Welsh, 1988). The installation of containment is being done under Project No. SJ-M-077 with completion expected early in 1989. The use of AFFF for training and performance testing purposes has been temporarily curtailed until the waste disposal issue is adequately addressed.

9.1.2.4.4 Category IV

1. Inadequate Reporting of Monitoring Data. St. James Terminal has not reported all of the data for samples collected in excess of permit monitoring requirements. The EPA and State permits require that all sampling results and the total number of analyses be included in the discharge monitoring report. The site has been satisfying stipulated sampling requirements, including

necessary increases in sampling frequency following any permit noncompliances detected; however, data from the additional sampling and the actual numbers of samples taken were not fully reflected in the site's discharge monitoring reports, as required under the discharge permits issued to the site.

PRELIMINARY

9.1.3 Groundwater/Soil

9.1.3.1 Background Environmental Information

The Chicot aquifer system is the principal regional aquifer at St. James. The upper strata of the Chicot are in direct hydrologic contact with the Mississippi River. Most of the groundwater contained in this aquifer is slightly brackish. In the St. James area, only the uppermost units contain fresh water (BPS, 1987h).

9.1.3.2 General Description of Pollution Sources/Controls

There are no specific sources of groundwater pollution at St. James Terminal other than the potential for contamination from crude oil spills. Controls on spills at the storage and dock facilities are addressed in the site-specific Spill Prevention, Control, and Countermeasures Plan (BPS, 1986j).

St. James Terminal has no process waste streams and no disposal sites. A storm-water retention pond and sewage treatment facilities are described in Section 9.1.2.2. The retention pond prevents discharge of aqueous film forming foam (AFFF), if use of the foam is required for fire fighting.

9.1.3.3 Environmental Monitoring Program

There is no groundwater monitoring program at St. James Terminal and none is required under existing environmental regulations.

9.1.3.4 Findings and Observations

9.1.3.4.1 Category I

None.

9.1.3.4.2 Category II

None.

9.1.3.4.3 Category III

None.

9.1.3.4.4 Category IV

None.

PRELIMINARY

9.2 Non-Media-Specific Survey Findings

This section discusses findings and observations pertaining to waste management, toxic and chemical materials, radiation, quality assurance, and inactive waste sites and releases. These discussions do not include a background environmental information section because the areas addressed are not necessarily tied to one medium, as was the case with the discussions in Section 9.1. These discussions include an environmental monitoring program section, where appropriate and where information was available.

9.2.1 **Waste Management**

9.2.1.1 Background Information

Operations at the St. James Terminal generate only nonhazardous oilfield wastes and nonindustrial solid wastes. They do not generate any hazardous, radioactive, radioactive/hazardous mixed, or industrial solid wastes. Brief descriptions of all these wastes are as follows:

- Nonhazardous oilfield wastes are wastes generated by the drilling and production of oil and gas wells, and which are not regulated by the provisions of the Louisiana Hazardous Waste Rules (LHWR) (Louisiana Statewide Order No. 29-B). Oilfield wastes include drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy [LHWR 1.3(d)(14)].
- Industrial solid wastes are wastes produced in the course of and resulting from any industrial, manufacturing, or mining process, and which are not subject to regulation under the Louisiana Hazardous Waste Management Plan. Trash, construction debris, and other non-process wastes are not considered industrial solid wastes (Louisiana Solid Waste Regulations, Chapter 3.0).
- Nonindustrial solid wastes include any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from commercial and agricultural operations, and from community activities; but does not include or mean solid or dissolved material in domestic sewage or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under Louisiana Revised Statutes (LA R.S.) 30:1094, or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.),

as amended, or hazardous waste subject to permits under LA R.S. 30:1131 et seq. (Louisiana Solid Waste Regulations, Chapter 3.0).

- Hazardous wastes include any wastes or combination of wastes, which because of their quantity, concentration, physical, chemical, or infectious characteristics may (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Such definition shall be applied only to those wastes identified and designated as such by the Department of Environmental Quality, consistent with applicable Federal laws and regulations (Louisiana Hazardous Waste Control Law, LA R.S. 30:1131).
- Radioactive wastes are wastes containing radioactivity (i.e., materials that emit radiation, such as alpha and beta particles, neutrons, electrons, and gamma rays).
- Mixed (radioactive and hazardous) wastes are co-contaminated with radioactive and hazardous waste materials.

Nonhazardous oilfield wastes are regulated by the Louisiana Department of Natural Resources Office of Conservation (LOC). Generators are responsible for the proper handling and transportation of these wastes to an approved commercial facility [Louisiana Statewide Order No. 29-B, Subparagraph 13.2(A)]. All shipments of oilfield wastes for off-site disposal must be accompanied by a properly completed LOC manifest, entitled Oil Field Waste Shipping Control Ticket, that is initiated by the generator (Louisiana Statewide Order No. 29-B, Subparagraph 13.6). The site must also use haulers that are registered with the Louisiana Public Service Commission to transport oilfield wastes. Because no oilfield wastes are disposed of on-site, no production pit notifications need to be submitted to the LOC.

Oilfield wastes are temporarily exempted from regulation as hazardous wastes under Section 3001(b)(2)(A) of the 1980 Amendments to RCRA, pending further study by EPA. After submission of study results to Congress, public hearings, and opportunity to comment, the Administrator of EPA must determine either to promulgate regulations under the hazardous waste management provisions of RCRA (Subtitle C) or to declare that such regulations are unwarranted. Because wastes generated from activities associated with storage of hydrocarbons are considered oilfield wastes, the temporary exemption applies to St. James oilfield wastes. Exempted wastes are defined in detail in the Report to Congress, Management of Wastes from the Exploration,

Development, and Production of Crude Oil, Natural Gas, and Geothermal Energy (EPA, 1987a), as well as the Louisiana Hazardous Waste Rules and Regulations [LHWR 1.3(d)(14)].

Nonindustrial solid wastes are regulated by the Louisiana Department of Environmental Quality (LDEQ) Solid Waste Management Division. Generators of these wastes are not required to use manifests (Louisiana Solid Waste Regulations). Because none of these wastes are disposed of at the St. James Terminal, no LDEQ permit is required.

Hazardous wastes are regulated by the LDEQ Hazardous Waste Management Division. LDEQ was granted authority from EPA in January 1985 to manage the RCRA hazardous waste program in Louisiana. However, because the site does not generate any hazardous waste, the site is exempt from the Louisiana Hazardous Waste Rules [LHWR 1.3(d)(1)]. Therefore, the St. James Terminal is not required to have waste management permits (e.g., RCRA storage, treatment, and disposal permits) or a waste generator identification number; nor does it need to submit generator reports. Before Louisiana was granted RCRA authority, EPA issued the site generator number LA1890032583 in response to SPR's 1980 Part A RCRA Section 3005 notification, but then reclassified the site to nonhandler status in June 1982, because it was a small quantity generator (Paul, 1982). If the site generates a hazardous waste, it must request from LDEQ a one-time-only EPA identification number to manifest and dispose of that waste off-site (LHWR 7.3). Quantities generated and accumulated on-site are subject to limitations established for small quantity generators [LHWR 1.3(d)(1)]. The site must also use haulers for hazardous wastes who are specifically registered with the Louisiana Public Service Commission and who possess an EPA identification number [LHWR 7.3(c)].

9.2.1.2 General Description of Pollution Sources/Controls

9.2.1.2.1 Nonhazardous Oilfield Wastes

Nonhazardous oilfield wastes include tank bottoms, sludges from oil/water separators and an oil sludge collection pit, and oil spill cleanup wastes. Tank bottoms are generated when the six oil storage tanks are cleaned out. Oily sludges are generated in the process of collecting spilled oil. Spilled oil flows into slop-oil tanks (sumps); three are located at the tank farm (SJT-7, SJT-8 and SJT-10), and one is located at each of the two docks. Storm water that could contain small quantities of oil (i.e., from areas likely to have oil spills) drains to oil/water separators (two for the tank farm and one for the two docks; Figure 9-5). Oil collected in the oil/water separators is pumped

Source: Adapted by DOE Environmental Survey Team from BPS, 1987h.

FIGURE 9-5

WASTE MANAGEMENT SITES AT ST. JAMES TERMINAL STRATEGIC PETROLEUM RESERVE

to a fourth slop-oil tank located at the tank farm (S-3) and the water is pumped to the retention pond at the tank farm (Figure 9-5). Oily sludge from the slop-oil tanks and oil/water separators is taken to the oil sludge collection pit (see Figure 9-5) to be dewatered and stored until shipped off-site for disposal. Cleanup wastes would be generated if a spill were to occur at a storage tank or if significant enough to overflow containment areas that direct spills to slop-oil tanks (i.e., at the booster pump pad, the meter skid area, the fill pump pad, and the pig trap area). Cleanup wastes would primarily consist of oil-contaminated soil and oily sorbent pads.

All oilfield wastes are collected in vacuum trucks or drums and shipped off-site for disposal with LOC manifests. According to site personnel, SPR uses waste haulers that are registered with the Louisiana Public Service Commission and commercial disposal facilities that are permitted by the LOC. St. James and the other Capline SPR sites (i.e., Weeks Island and Bayou Choctaw) currently use two commercial nonhazardous oilfield waste disposal facilities:

- Reliable Production Services in Livonia, Louisiana
- Intracoastal Oilfield Fluids in Bourg, Louisiana

It is DOE's policy to only send waste to commercial sites that have been used extensively in the past by DOE SPR contractors and that do not have any outstanding compliance orders (i.e., that are well-known to DOE and have a long history of successful operation; Russell, 1988a). Operations at these sites and the sites' regulatory status are routinely reviewed by SPR personnel and approved for use. This policy is also to be followed by subcontractors working under BPS, where BPS fills out the Oil Field Waste Shipping Control Ticket. Such a policy will reduce DOE's potential future liability as a "responsible party," in the event that a commercial disposal facility being used will have to be cleaned under a CERCLA action. A review of waste manifests revealed that oilfield wastes from the St. James Terminal were only sent to the Reliable Production Services facility during 1987. Twenty-eight manifests for shipments of oil sediment/diesel/water were in the site files for that year.

9.2.1.2.2 Nonindustrial Solid Wastes

Nonindustrial solid wastes include trash, construction rubble and spoil, and chemical toilet waste. These wastes, except the chemical toilet waste, are disposed of in dumpsters or directly into the trucks that haul the wastes off-site. The chemical toilet waste is taken to the local publically-owned wastewater treatment facility via vacuum truck. The other wastes are taken to the Browning-Ferris Industries Colonial Landfill located in Sorrento, Louisiana.

9.2.1.2.3 Hazardous Wastes

The St. James Terminal operations do not generate any hazardous wastes. The analytical laboratory does not have laboratory wastes or excess chemicals to dispose of. Small quantities of laboratory reagents, which include hazardous substances such as xylene and acetone, are either consumed or mixed with the crude oil being analyzed. The oil never becomes a waste, because these reagents are not considered wastes when mixed with the oil. The oil/reagent mixture is disposed of in the laboratory sink; the sink drains to a slop-oil tank; and the tank contents are pumped to one of the crude-oil surge tanks (i.e., Tank No. 1).

Construction and maintenance subcontractors working on site sometimes generate small quantities of hazardous wastes (e.g., paint wastes), but their contracts are written so that they retain ownership and responsibility for the removal and proper reclamation or disposal of all unused and waste materials. If the site were to generate a hazardous waste on a one-time basis, the site would request, from LDEQ, a generator number for a one-time authorization to dispose of the waste off-site.

9.2.1.2.4 Underground Storage Tanks

There are seven underground storage tanks (USTs) at the St. James Marine Terminal. Four are slop-oil tanks used to contain crude oil, one contains gasoline, one contains diesel fuel, and one has never been used. None have been used to store wastes. Three of the slop-oil tanks (i.e., SJT-7, SJT-8, and SJT-10) have a 1,000-gallon capacity, and one (i.e., S-3) has a 5,400-gallon capacity. The fuel tanks each can hold 2,000 gallons and the empty tank has a 1,000-gallon capacity. All are made of steel and all tanks in service have cathodic protection. At the time of the DOE Environmental Survey, all the tanks were under 10 years old. Although SPR does not have a leak detection program for USTs, the potential for UST leakage at the St. James Marine Terminal appeared to be low and does not present, at this time, a significant environmental risk. In addition, all seven USTs were reported to the state per RCRA Subtitle I requirements (Teerling, 1986d).

9.2.1.3 Findings and Observations

9.2.1.3.1 Category I

None.

9.2.1.3.2 Category II

None.

9.2.1.3.3 Category III

None.

9.2.1.3.4 Category IV

None.

PRELIMINARY

9.2.2 Toxic and Chemical Materials

9.2.2.1 General Description of Pollution Sources/Controls

9.2.2.1.1 Toxic Management

The control of toxic and chemical materials at St. James Terminal is the combined responsibility of the Purchasing, Quality, Safety, and Environmental Departments. The Environmental Specialist for St. James Terminal has informed the Purchasing Department representative for the site that Material Safety Data Sheets (MSDSs) must accompany any shipment of toxic and chemical materials received at St. James Terminal (Russell, 1988b).

An inventory of the toxic and chemical materials used at the site and the MSDSs for these materials are maintained at St. James Terminal. The Purchasing Department is currently responsible for circulating purchase requisitions to representatives of the St. James Terminal Safety and Environmental Departments for review. This manual method of approving purchase requisitions was being phased out at the time of the Environmental Survey and replaced with a computer-based system termed the Materials Management system. The Environmental Department can reject the purchase or use of a particular hazardous material at St. James Terminal, due to potential environmental or occupational health concerns.

The primary locations at St. James Terminal used for the storage of toxic and chemical materials are the Flammable Storage Building and the Drum Storage Area, both in the St. James Terminal Laydown Yard (see Figure 9-5). These locations were inspected during the Environmental Survey, and no deficiencies regarding the storage of toxic and chemical materials were noted at the Flammable Storage Building. An impervious (concrete) floor and curbing have been installed in the Flammable Storage Building to contain spills. However, at the Drum Storage Area in the Laydown Yard, drums containing chemical products are currently stored out-of-doors and are unprotected (i.e., lacks a roof and walls) from adverse weather conditions at locations without impervious flooring and curbing to contain spills. In the event of a drum leak or rupture, spilled substances would contaminate surrounding soils and could be released into nearby surface waters. At the time of the Environmental Survey, the Drum Storage Area in the Laydown Yard contained approximately ten 55-gallon drums of AFFF (one leaking), 7 drums of various acids, 2 drums of solvent, 32 drums of various oils, and 11 drums of different chemicals. Deficiencies regarding the storage of toxic and chemical materials were previously identified during an EPA inspection of the Weeks Island site (Townsend, 1986), the DOE-PMO Site Management Appraisal at the St. James Marine Terminal (Wagoner, 1987), and in an environmental audit of the St. James Terminal site conducted by the

operating contractor (Teerling, 1987m). Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous waste) above-ground tanks and drum storage areas, such measures are considered good management/operational practice. A request to install covered drum storage racks at all SPR sites was submitted to DOE by BPS, but was not authorized (Teerling, 1987d). BPS is in the process of submitting similar requests to DOE-PMO to construct such facilities on a site-specific basis.

At present, St. James Terminal uses the labels placed upon containers of toxic and chemical materials by the manufacturer to inform workers of the potential hazards associated with these materials. Regular inspections are conducted to determine if the labels are present. However, St. James Terminal is considering the implementation of a site-specific internal labeling system for this purpose. Although not required by current regulations, in general, site-specific labeling systems are increasingly being used to facilitate compliance with such regulations. In addition, BPS has established formal procedures to comply with the requirements of the OSHA Hazard Communication Standard and similar requirements imposed by Louisiana (BPS, 1987b).

9.2.2.1.2 Tank Farm Facilities

Underground Storage Tanks

Seven USTs are present at St. James Terminal (Teerling, 1986d). None have been used to store wastes. For a complete discussion of the USTs at St. James Terminal, see Section 9.2.1.2.4.

Above-Ground Storage Tanks

Six above-ground storage tanks, commonly referred to as surge tanks, are used to temporarily store crude oil at St. James Terminal during fill and withdrawal operations. Four of these six tanks have a capacity of 16.8 million gallons each; the remaining two above-ground crude-oil storage tanks have a capacity of 8.4 million gallons each. Secondary containment dikes capable of containing the entire volume of any one tank have been constructed around these tanks (BPS, 1986j). These tanks are also equipped with high-level alarms that notify the Control Room when any tank is in danger of overflowing.

In addition to the large above-ground storage tanks, several other above-ground tanks are used for the storage of toxic and chemical materials. These include

- A 1,000-gallon capacity diesel tank at the emergency generator. A secondary containment dike (e.g., a secondary containment measure in the event of a spill, i.e., overflow, tank rupture, etc.) has been constructed around this tank.
- A 500-gallon and a 250-gallon diesel tank at the fire pumps at Dock No. 1. They share a common collection basin which drains to the dock's stormwater collection sump.
- A diesel tank (approximately 200-gallon capacity) at the new fire water pump building. At the time of the Environmental Survey, this tank had an undersized containment dike. In addition, a drain had been built within the dike that discharged outside the building into the surface drainage ditch (Russell, 1988e). At the time of the on-site portion of the Environmental Survey, the tank was empty and site personnel had notified BPS management of these deficiencies. (Since the on-site portion of the Environmental Survey, SPR has informed the team that the drain has been redirected to a closed sump.)
- An approximately 500-gallon capacity tank used to store corrosion inhibitor at the Pig Trap/Separator Area. A previous limestone dike has been constructed around this tank.

9.2.2.1.3 Spill Prevention, Control, and Countermeasures (SPCC) Plan

St. James Terminal handles large volumes of crude oil and is located close to navigable waters. As a result, the requirements of the EPA Oil Pollution Prevention regulations (40 CFR 112) are particularly applicable to the site. In response to these requirements, St. James Terminal has prepared and implemented an SPCC Plan (BPS, 1986j) and a Spill Contingency Plan (BPS, 1986h). These documents contain listings of potential spill sources, the type and quantity of material that would be released, personnel and equipment resources, and spill evaluation, support, and response procedures.

Engineering controls have also been implemented at the site. Both of the St. James Terminal docks have been equipped with a spill containment dike capable of retaining approximately 28,000 gallons of crude oil. A float-activated sump pump on each dock can transfer any spilled crude oil to an oil/water separator for the docks (see Section 9.1.2.2.4). Storm water from the areas enclosed by the dikes for the 8.4 to 16.8 million gallon capacity, above-ground surge tanks drains through three oil/water separators. Water from these separators is treated and discharged to the 2.1 million-gallon capacity retention pond. Four underground storage tanks receive oil from various oil drains and

pressure-relief systems. A concrete sump at the Pig Trap Area is connected by drains to the oil/water separator for the surge tanks. The meter prover stations for the Bayou Choctaw and Weeks Island pipelines, as well as the main booster pumps, are on curbed concrete pads. Spills from the main booster pumps would drain to the oil/water separator at the surge tanks.

An Emergency Response Team (ERT) has been organized at St. James Terminal. All ERT members receive 40 hours of training yearly at the ERT Academy of Lamar University (Russell, 1988d). Some ERT members have also attended 40 additional hours of training on oil spill control and cleanup at Texas A&M University. An inventory of spill control equipment is maintained at the site.

Formal monthly inspections of the site for deficiencies related to spill prevention and control are performed by the Capline Environmental Specialist (BPS, 1986j). The inspection report is forwarded to the St. James Terminal Site Manager for review and approval.

SPR has established formal reporting requirements for oil spills of one or more barrels or oil spills of any quantity on navigable waterways. Similar reports must be prepared for brine spills of any quantity leaving the site or five or more barrels on-site. For spills of hazardous substances, the reporting requirements established by EPA have been implemented. During CY 1986, one reportable oil spill but no reportable brine spills occurred at St. James Terminal (Teerling, 1987e). The oil spill was contained on-site.

9.2.2.1.4 Polychlorinated Biphenyls (PCBs)

It is the policy of SPR not to permit any equipment that is known to contain fluids with PCB concentrations in excess of 5 parts per million (ppm) on any SPR site (BPS, 1987e). There are currently six oil-filled transformers at St. James Terminal. When the oil in these transformers was tested in 1983, the oil in all transformers was shown to contain less than 1 part per million (ppm) PCBs (Fisher, 1983b). According to these results, the six oil-filled transformers at St. James Terminal are non-PCB transformers. No PCBs are known to be present at the site.

9.2.2.1.5 Pesticides

Pesticides (i.e., insecticides, herbicides, and rodenticides) are used at St. James Terminal and are applied by both site and contractor personnel. Restricted-use pesticides (i.e., pesticides that according to EPA must be applied only by a certified pesticide applicator or persons directly supervised by a certified pesticide applicator) are used only by contractor personnel who are licensed to handle such materials (Teerling, 1987f). Currently, site personnel apply Amdro insecticide for

fire ant control and Roundup and Pramitol 25-E for weed control. No spraying of insecticides for mosquito control is conducted. Written procedures governing the use of pesticides at St. James Terminal have not been established. Application records are not maintained. Site personnel have indicated that pesticides are applied in accordance with the directions on the pesticide container labels.

The supply of the pesticides used by site personnel is stored at the Warehouse and Maintenance Shop. These locations were inspected during the Environmental Survey and were found to be in an orderly condition, with no evidence of leaks or spills. Any mixing of pesticides required prior to application is conducted at the Maintenance Shop.

In addition to the herbicides that are applied by personnel at the site, a crew stationed at St. James Terminal is responsible for spraying herbicides at road crossings and valve stations on the Weeks Island, Bayou Choctaw and St. James Terminal crude oil pipelines, and the Bayou Choctaw brine discharge and raw-water-intake lines. Herbicide 2,4-D is used for this purpose. Application records are not maintained. A commercial aerial spraying contractor is also used to spray herbicides (Tordon K and Esteron 99) along the entire length of these pipelines. This contractor meets all the requirements for aerial herbicide spraying mandated by the Louisiana Department of Agriculture (Calhoun, 1986).

9.2.2.1.6 Asbestos

SPR operations began in the late 1970s. As a result, the various SPR sites, including St. James Terminal, were constructed using relatively little asbestos-containing materials. However, asbestos-containing gaskets are in place on the SPR pipelines. SPR has established procedures for properly removing and disposing of these asbestos-containing gaskets during routine maintenance (BPS, 1986c). These procedures will be utilized at St. James Terminal until all asbestos-containing gaskets have been properly removed, disposed, and replaced with asbestos-free gaskets.

9.2.2.1.7 Chlorofluoroalkanes

About 800 pounds of chlorofluoroalkanes are used at St. James Terminal annually (Teerling, 1987h). These materials are used as refrigerants in air conditioning units. As a group, the chlorofluoroalkanes are relatively volatile compounds. Potential environmental problems, due to vapor emissions, can result if they are not properly handled and stored. All of the chlorofluoroalkane purchased by St. James Terminal in 1987 was CFC-22. The supply of CFC-22 has

been stored indoors at the Warehouse until needed. During the Environmental Survey, chlorofluoroalkanes appeared to be stored properly at St. James Terminal.

9.2.2.2 Findings and Observations

9.2.2.2.1 Category I

None.

9.2.2.2.2 Category II

None.

9.2.2.2.3 Category III

1. Inadequate Secondary Containment Measures. There is a potential for releases of oil and chemical materials into the environment from above-ground tanks and drum storage areas lacking effective spill containment. Drums containing chemical products are currently stored out-of-doors, unprotected from adverse weather conditions at locations lacking impervious flooring and curbing to contain spills. In the event of a tank/drum leak or rupture, spilled substances would contaminate surrounding soils and could possibly be released into nearby surface waters. These deficiencies were identified during an EPA inspection of the Weeks Island site, the DOE Site Management Appraisal at the St. James Marine Terminal, and in an environmental audit of the St. James Terminal conducted by BPS. Although neither state nor Federal regulations currently require secondary spill containment for certain (nonhazardous waste) above-ground tanks and drum storage areas, such measures are considered good management/operational practice.

Deficient storage of chemical products noted by the Environmental Survey Team at St. James Marine Terminal are

- The Drum Storage Area in the Laydown Yard at St. James Terminal is out-of-doors, unprotected from the elements, and does not have curbing and impervious flooring to contain potential spills. About ten 55-gallon drums of AFFF (one leaking), 7 drums of various acids, 2 drums of solvents, 32 drums of various oils, and 11 drums of various chemicals are stored in this area.

- A 200-gallon diesel tank in the fire water pump building under construction at St. James Terminal was inappropriately diked. A drain in the floor discharged directly to the ditch that receives storm-water runoff. At the time of the on-site portion of the Environmental Survey, the tank was empty and posed no potential environmental problem until it was filled. Since the on-site portion of the Environmental Survey, SPR has informed the team that the drain has been redirected to a closed sump.
- A pervious limestone dike has been constructed around the 1,000-gallon capacity tank used to store corrosion inhibitor at the Pig Trap/Separator Area.

9.2.2.2.4 Category IV

None.

9.2.3 Radiation

9.2.3.1 Background Information

The regulations applicable to the radioactive sources used at the St. James Marine Terminal are summarized in Section 5.2.3.1.

9.2.3.2 General Description of Pollution Sources/Control

There are no gamma-ray densitometers at the St. James Marine Terminal and no well-logging sources have been lost at the site.

There is one sulfur analyzer at the site. This unit uses an iron-55 source (approximately 50 mCi) as an x-ray source. This source must be leak-tested every 6 months. The most recent leak test of this source was in October 1987. No leaks were detected.

9.2.3.3 Findings and Observations

9.2.3.3.1 Category I

None.

9.2.3.3.2 Category II

None.

9.2.3.3.3 Category III

None.

9.2.3.3.4 Category IV

None.

9.2.4 Quality Assurance

9.2.4.1 General Description of Data Handling Procedures

The quality assurance aspects of the environmental monitoring program at the St. James Marine Terminal are governed by the requirements of the BPS Environmental Programs and Procedures Manual (Teerling, 1986c). The requirements of this manual are summarized in Section 3.2.4.1. The environmental monitoring program at the St. James Marine Terminal includes NPDES-required discharge monitoring of storm-water runoff and sewage treatment plant discharges. The environmental water monitoring at St. James is described in more detail in Section 9.1.2.3.

There is no environmental laboratory located at the St. James Marine Terminal and no analyses other than field pH determinations are conducted on-site. There is a laboratory at the St. James site; however, it is dedicated to analysis of crude oil and is not equipped for environmental water analysis. Analyses of St. James environmental samples are generally conducted at the Bayou Choctaw Laboratory, although samples may be sent to commercial laboratories if (1) the Bayou Choctaw Laboratory is inoperative or (2) it would be impractical to transport a sample to Bayou Choctaw before a holding time would be exceeded.

The Survey team observed sample collection and a pH determination at St. James. A written sampling procedure was available. The pH determination was made in the field using a portable wand-type pH meter. The meter was calibrated in the crude-oil laboratory before use and all calibration information was recorded in a bound logbook. Sampling information and the pH results were recorded in the field in a bound notebook.

9.2.4.2 Findings and Observations

9.2.4.2.1 Category I

None.

9.2.4.2.2 Category II

None.

9.2.4.2.3 Category III

None.

9.2.4.2.4 Category IV

None.

PRELIMINARY

9.2.5 Inactive Waste Sites and Releases

9.2.5.1 Background Information

The Survey team investigated each of the SPR facilities to identify inactive waste sites and releases of hazardous materials that are sources or potential sources of environmental contamination. Inactive sites and hazardous materials releases reviewed by the Environmental Survey team may either be subject to various environmental regulations or may not be addressed by the environmental regulatory framework. The Survey team identified and inventoried all inactive sites and hazardous materials releases that may cause environmental problems, regardless of the regulatory status of the sites or materials involved. Document reviews, personal interviews, and brief site visits were the basis for the observations and findings described in this section.

Many of the inactive waste sites and releases identified by the Survey team may be subject, via the Federal facilities provision, to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and associated Executive Orders. Therefore, DOE Order 5480.14 (under revision) was issued on April 26, 1985 to implement DOE's CERCLA Program, which is intended to define actions for identification and evaluation of inactive hazardous waste sites on DOE installations and to effect remedial actions, where warranted. The first two phases of a five-phased program, prescribed under DOE Order 5480.14, were completed before the Survey team visited the SPR sites. A report was prepared under each of these two phases--the Phase I CERCLA Report: Installation Assessment, April 1986 (BPS, 1986b) and the Phase II CERCLA Report: Confirmation, April 1987 (BPS, 1987f). According to DOE 5480.14, Phase I was intended to "evaluate site history and records, and to locate and identify those inactive hazardous waste disposal sites that may pose a risk to health, safety and the environment as a result of migration of hazardous substances." Phase II was described by DOE 5480.14 as an effort to "quantify, by preliminary and comprehensive environmental survey, the presence or absence of hazardous substances that may pose a risk to health, safety, and the environment." The Survey team used the Phase I and II CERCLA Reports to aid in identifying and evaluating inactive waste sites and releases.

Since passage of the Superfund Amendments and Reauthorization Act (SARA) of 1986, DOE has revised its CERCLA program and DOE Order 5480.14 to implement the new SARA requirements. DOE has replaced the five-phased program and adopted the Environmental Protection Agency (EPA) program as outlined in the National Contingency Plan. DOE also issued guidance to its facilities on how to use data collected under its old CERCLA program to meet requirements of SARA. Conversion of Phase I CERCLA Reports (i.e., Installation Assessments) to Preliminary Assessments (i.e., the first step under the EPA program) was to be completed by April 1988.

This section summarizes the potential for uncontrolled releases of hazardous substances into the environment from inactive waste sites and spills at the St. James Terminal. Information was obtained from SPR personnel and files as well as the Phase I CERCLA Report (BPS, 1986b). The Phase II CERCLA Report (BPS, 1987f) does not discuss St. James, because no additional investigations were needed beyond the Phase I CERCLA Report. No inactive waste sites or significant releases were identified in the Phase I Report.

9.2.5.2 General Description of Pollution Sources/Controls

The DOE Survey team found no evidence of any inactive waste disposal sites or contaminated areas from past spills and leaks at the St. James Terminal. DOE operations at the Terminal do not generate any hazardous wastes (see Section 9.2.1) and no hazardous wastes have been disposed of on site since DOE has occupied the property. Sometimes construction and maintenance subcontractors working at the site generate some hazardous wastes (e.g., paint wastes), but under contract terms, they are responsible for removing such wastes from the site and disposing of them at approved off-site facilities. In addition, prior to the DOE acquisition of the property, the land was used as farmland. The primary crop was sugar cane. No past activities resulting in the production of hazardous wastes are known to have been conducted on-site. Also, no hazardous wastes are known to have been disposed of on-site. Furthermore, no buried waste materials were discovered during construction activities, (e.g., excavation) associated with the Terminal (BPS, 1986b).

Oil spills have occurred at the St. James Terminal, but all spills have been cleaned up. A review of SPR spill incident reports revealed that no other hazardous substance has been spilled. In addition, no spills from adjacent facilities have entered on DOE property, according to site personnel. No surface contamination was evident at the time of the DOE Environmental Survey. File review indicated that there had been 10 oil spills. Five spills were greater than 1 barrel (42 gallons) and had been reported to various agencies, including the state. All oil spills greater than one barrel must be reported to the Louisiana Department of Environmental Quality [L.R.S. 30:1073(J), Act 300 of 1982, as amended by Act 824 of 1984]. Only one spill was significant. In July 1981, there was a release of 6,300 barrels to the ground adjacent to one of the storage tanks (Tank No. 3). However, all the oil was contained within tank dikes. Most of the oil was recovered. The contaminated soils were biologically treated in place with selected strains of bacteria and nutrients. The area has recovered to pre-spill conditions.

9.2.5.3 Findings and Observations

9.2.5.3.1 Category I

None.

9.2.5.3.2 Category II

None.

9.2.5.3.3 Category III

None.

9.2.5.3.4 Category IV

None.

PRELIMINARY

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APPENDIX A

SURVEY PARTICIPANTS

STRATEGIC PETROLEUM RESERVE SURVEY PARTICIPANTS

	November 30, 1987 through December 11, 1987	February 1, 1988 through February 10, 1988
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DOE

Team Leader	T. T. Traceski	T. T. Traceski
Assistant Team Leader	D. A. Bergman	D. A. Bergman
Project Management Office Representative	S. Evans	S. Evans

NUS

Coordinator/Surface Water	R. E. Tarbert	R. E. Tarbert
Radiation/QA	J. D. Yesso	J. D. Yesso
Air	T. F. Eckle	T. F. Eckle
Toxic Materials	R. C. Gerlach	R. C. Gerlach
Hydrogeology	M. S. Robison	M. S. Robison

ICF TECHNOLOGY

Waste Management	G. M. Kelly	G. M. Kelly
Inactive Waste Sites	D. Ouderkirk R. L. Scullin G. M. Kelly	G. M. Kelly

APPENDIX B

SURVEY PLAN

U.S. Department of Energy

Environment, Safety and Health Office of Environmental Audit

Strategic Petroleum Reserve Environmental Survey Plan Phase I

November 30 - December 11, 1987

ENVIRONMENTAL SURVEY PLAN

STRATEGIC PETROLEUM RESERVE

BRYAN MOUND - BRAZORIA COUNTY, TEXAS

BIG HILL - JEFFERSON COUNTY, TEXAS

WEST HACKBERRY - CAMERON PARISH, LOUISIANA

SULPHUR MINES - CALCASIEU PARISH, LOUISIANA

NOVEMBER 30 - DECEMBER 11, 1987

1.0 INTRODUCTION

The Strategic Petroleum Reserve (SPR) Environmental Survey is part of the larger Department of Energy (DOE)-wide Environmental Survey effort announced by Secretary John S. Herrington on September 18, 1985. The purpose of this effort is to inventory, via "no fault" baseline Surveys, existing environmental problems and areas of environmental risk at DOE facilities, and to rank them on a DOE-wide basis. This ranking will enable DOE to more effectively establish priorities for addressing environmental problems and allocate the resources necessary to correct these problems. Because the Survey is "no fault" and is not an "audit", it is not designed to identify specific isolated incidents of noncompliance, or to analyze environmental management practices. Such incidents and/or management practices will, however, be used in the Survey as a means of identifying existing and potential environmental problems.

The SPR Survey will be conducted in accordance with the protocols and procedures contained in the Environmental Survey Manual, August 1987.

2.0 SURVEY IMPLEMENTATION

The Environmental Survey of the Strategic Petroleum Reserve (SPR) will be managed by the DOE Team Leader, Thomas Traceski and the Assistant Team Leader, Donna Bergman. Sidney Evans from the SPR Project Management Office (PMO) will serve as the designated operations Office representative on the Environmental Survey Team. Technical support is provided by NUS Corporation and ICF Corporation personnel as follows:

Richard Tarbert	NUS Coordinator/Surface Water
David Yesso	Assistant NUS Coordinator/Radiation/QA
Richard Gerlach	TSCA (Toxic Materials)
Tom Eckle	Air
Gerard Kelly	RCRA/Solid Waste
David Ouderkirk/ Ronald Scullin	CERCLA (Inactive Sites)
Mary Robison	Hydrogeology/Soil

2.1 Pre-Survey Activities

Pre-Survey activities began in August, 1987, when the DOE Team Leader and Assistant Team Leader initiated reviews of SPR environmental documents that were available at the DOE Office of Environmental Audit (OEV). This review was followed by a September 1, 1987, memorandum from OEV to the Oak Ridge Operations Office (ORO) and the Strategic Petroleum Reserve announcing a pre-Survey site visit and requesting additional Survey-related information. The

technical specialists began their review of the documents available at OEV in September 1987. The purpose of the review of that material was to allow the Survey team members to gain familiarity with SPR and prepare themselves for the pre-Survey site visit.

Four members of the Survey team, Thomas Traceski, Donna Bergman, David Yesso, and Mary Robison, conducted the pre-Survey site visit on October 13 through 15, 1987. The visit was scheduled to allow team members an opportunity to gain initial familiarity with a representative SPR site, identify potential areas of environmental concern, explain the objectives and methodology of the Survey, collect and review the documents requested in the September 1, 1987 memorandum, and coordinate plans for the upcoming Survey with DOE/ORO, DOE/SPR-PMO, and the operating contractor Boeing Petroleum Services (BPS). Mr. Maury Walsh, Battelle, Columbus Division, who will coordinate the sampling and analysis phase of the Survey, also attended the pre-Survey site visit.

During the pre-Survey site visit, team members were provided with detailed briefings by BPS and DOE/SPR-PMO personnel on the SPR organization, operations, and activities; environmental issues; site security; safety; industrial hygiene; and the plant environmental programs. Of particular value to the team was the tour of Bayou Choctaw, a representative SPR site. Following the briefings provided on October 13, 1987, team members had an opportunity to review the environmental documents that had been assembled by SPR-PMO and BPS personnel. Based upon this review, the briefings, and the tour, a limited number of additional documents were identified and requested by team members. Arrangements were made to have the collected materials

shipped to the NUS offices in Pittsburgh. All of the documents that were requested in the memorandum of September 1, 1987, and during the pre-Survey site visit have been received. This Survey plan is based upon material received by the Survey team through the end of October 1987.

In conjunction with the pre-Survey site visit, Messrs. Traceski and Yesso, and Ms. Bergman, of the Survey team, along with Sidney Evans (DOE/SPR-PMO) and William Bozzo (BPS) met, in separate meetings, with officials from the U.S. EPA, Region VI, the State of Louisiana, and the State of Texas. These meetings were scheduled to explain the purposes of the Survey to personnel from the cognizant Federal and state regulatory agencies and to allow them to express their concerns over the environmental conditions of the SPR sites.

2.2 On-Site Activities and Reports

The on-site portion of the Environmental Survey will be conducted in two phases. The first phase, to be conducted during the two week period November 30 through December 11, 1987, will include the four westernmost sites in the Seaway and Texoma Systems: Big Hill, Bryan Mound, West Hackberry, and Sulfur Mines. The second phase, to be conducted during the two week period from February 1 through February 12, 1988, will include the three sites in the Capline System: Bayou Choctaw, Weeks Island, and the St. James Marine Terminal. A brief introductory meeting will be held on the team's first morning at each site. The purpose of these meetings is two-fold: First, introduce the Survey team to the management and environmental personnel at each site and to briefly review the objectives of the Survey; and second,

these meetings will provide the Survey Team with safety and security briefings by site personnel as well as a site-specific overview of the environmental program at each SPR location. A detailed site tour will follow the briefings. The Survey team requests that at each site, the site Environmental Specialist, site Field Chemist, an operations representative, and a maintenance representative be present for the duration of each tour to answer questions. The Survey team expects that the tours will require approximately four hours at each site.

Since only the Quality Assurance Specialist requires a tour of laboratory facilities, they should not be included in the initial site tour, but scheduled separately. The Survey will include consideration of all facilities and areas associated with the Strategic Petroleum Reserves.

A tentative Survey agenda is shown in Table 2-1 and a summary of the agenda is included as Table 2-2. As members of the Survey team continue their review of site documents, and gain information during the site visit, it is anticipated that modifications to the agenda will be needed to minimize disruption of site activities as well as to optimize the efficiency and effectiveness of the Survey. All modifications will be coordinated through the SPR-PMO and BPS personnel designated as Survey contacts.

The on-site activities of the Survey team will consist of interviews and consultations with, among others, environmental, industrial hygiene, safety, operations, maintenance, waste management, purchasing, and warehousing personnel; a review of files and documents unavailable to the team prior to the on-site portion of the Survey; technical-specialty-specific tours of limited areas of the site.

At the conclusion of the team's visit to each site, the Survey team will hold technical accuracy meetings (reality check) with the site personnel. These meetings will include a presentation of the preliminary findings to site technical personnel to verify that the Survey team's understanding of an issue is correct and that there is no additional information on the subject that the team should consider. If site personnel identify issues requiring follow-up, this will be accomplished as soon as possible, following the meeting. In order to optimize the use of time, the Survey team may request that selected site personnel be available at Big Hill on Saturday, December 5, 1987 for technical-accuracy follow-up, if needed. In addition, the DOE Team Leader and Assistant Team Leader will be available for a brief exit meeting with site management prior to departure. A teleconference closeout briefing will be conducted on Friday, December 11, 1987, to describe preliminary findings of the entire two-week on-site activities.

A Survey status report will be prepared within 2 weeks after the conclusion of each on-site portion of the Survey. A Preliminary Report of the overall Survey (Phases One & Two) will be prepared within 14 to 16 weeks from the conclusion of the on-site Survey activities. Public distribution of the Preliminary Report will be at the discretion of the Oak Ridge Operations Office and the SPR-PMO although copies will be made available to members of Congress and EPA Headquarters, upon request. Subsequently, an Interim Report will be prepared by the Survey team within 6 to 8 weeks of the completion of sample analysis. The Interim Report will incorporate PMO/BPS technical comments to the Preliminary Report and the data from the sample analyses.

The Interim Report will be made available to the public, upon request. At the completion of the overall Environmental Survey effort, a final report will be prepared that will contain a DOE-wide list of environmental problems. The report will be used as an information base for the ranking of DOE's environmental problems.

2.3 Sampling and Analysis

Based on available site environmental information and the results of the Survey activities on site, the SPR Survey Team will identify any Survey-related sampling needs. Preparation for the sampling and analysis (S&A) phase of the Survey process will begin approximately 2-4 weeks after the completion of each phase of the on-site Survey, with the development of the sampling request package. The S&A effort will be conducted by Battelle, Columbus Division (BCD). Maury Walsh will be the BCD Team Leader for the Sampling and Analysis phase of the Environmental Survey. The BCD Sampling and Analysis team will draft the Sampling and Analysis Plan based upon the needs identified by the Survey team. The Assistant Team Leader will coordinate the review of this Sampling and Analysis Plan with the SPR Project Management Office and EPA's Laboratory at Las Vegas (Environmental Monitoring Systems Laboratory) which has quality assurance responsibility for the Survey's Sampling and Analysis efforts. The actual on-site sampling at the SPR is projected to start during the summer of 1988. The sampling is expected to take between 2 and 4 weeks to complete. Analysis of the samples will be conducted by Battelle following protocols provided in the Survey Manual, supplemented by the SPR Sampling and Analysis Plan. Results of the Sampling and Analysis will be transmitted to the Survey Team Leader for incorporation into the Interim Report.

3.0 AIR

The air-related portion of the Survey will involve an assessment of activities that emit or have a potential to emit one or more air-contaminating materials, the emission controls or administrative procedures applied to restrict those emissions, and any ambient air-quality monitoring equipment and procedures. The Survey will address those air contaminants for which air-quality standards (criteria pollutants) or emission standards (new source performance standards or emission standards for hazardous air pollutants) have been established by the United States Environmental Protection Agency or by Texas or Louisiana Air Pollution Control Regulations. Also to be reviewed are tanks regulated under 40 CFR 60, subpart K, New Source Performance Standards.

The primary SPR contacts for the air specialist will be designated by PMO/BPS to suit the plan indicated in Table 2-2.

3.1 Issue Identification

As a result of a preliminary review of documents provided by the Strategic Petroleum Reserve Project Management Office and information provided during the pre-Survey site visit, hydrocarbons (volatile organic compounds) represent the air contaminant of greatest concern. Emissions of volatile organic compounds, total suspended particulates, sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, hydrogen sulfide, and any other air contaminants such as gases released during a well purge, will be considered as part of the Survey.

The general approach of the Survey will include a review of existing air permits and any pending applications, as well as pertinent literature including standard operating procedures. Emission sources and emission-control equipment will be inspected, with emphasis on operations and activities capable of emitting, but not limited to, volatile organic compounds to the atmosphere. Of special interest will be the emissions from oil/brine separation ponds and from tanks. Fugitive emissions from valve stems and pump seals will be investigated. Resuspension of dust from unpaved roads will be evaluated as a potential source of airborne particulate contaminants. Air contaminant sources that do not have or do not require air permits and any emission-control strategies will also be reviewed.

In addition, the Survey will review any air-monitoring devices and procedures used to monitor atmospheric contaminants. The equipment and techniques to monitor fugitive emissions of volatile organic compounds from valve stems and pump seals will be observed.

Several areas of specific interest have been identified as a result of a preliminary review of available documents:

- o Sources or potential sources of volatile organic compound emissions to the atmosphere.
 - Crude oil storage tanks.
 - Slop oil tanks.

- Oil/Brine separation ponds.
- Valve stems and pump seals.
- o Sources or potential sources of particulate dust emissions to the atmosphere.
 - Vehicular traffic on unpaved roads.
 - Stationary diesel engines.
 - Wind-blown dust.

Throughout the Survey, emphasis will be placed on assessing available data and any future data generated by SPR within the timeframe of the overall Survey to characterize the overall environmental impact of SPR operations. Where data gaps exist, recommendations for additional sampling and analysis may be developed for follow-up by the Sampling and Analysis Team.

3.2 Records Required

Additional documents will be reviewed as part of the Survey, including documents not yet received (e.g., classified documents, individual files, and documents not yet identified). Specific documents and files requested for review while on-site include, but will not be limited to, the following:

Bryan Mound

- o Tank seal inspection records as required by 40 CFR 60, subpart K.
- o Data and calculations used to prepare monthly carbon compound emission inventory for surge tanks.
- o Basis for "Emission Sources - Maximum Allowable Emission Rates" published as part of TACB Permit No. C-6176B.
- o Monitoring reports for fugitive hydrocarbons from valve stems and pump seals.
- o Any demonstrations of compliance with Maximum Allowable Emission Rates for:
 - Surge Tanks
 - Sump Tanks
 - Oil/Brine Separation System
 - Fugitive Emissions - Pump Station

Big Hill

- o Basis for "Emission Sources - Maximum Allowable Emission Rates" published as part of TACB Permit No. C-9256.

- o Records of dust suppressant applications on plant roads.
- o Sample of form to be used in monthly reporting of carbon compound emissions from storage tanks and loading operations.

West Hackberry

- o Basis for "Actual" Hydrocarbon Emissions reported as part of LACC Permit No. 1048.

Sulphur Mines

- o Basis for "Actual" Hydrocarbon Emissions reported as part of LACC Permit No. 1042.

4.0 SURFACE WATER/DRINKING WATER

The surface water related portion of the Strategic Petroleum Reserve (SPR) Environmental Survey will be concerned with the liquid discharges from stormwater and sanitary waste treatment facilities at each site. It will also be concerned with the discharges of brine to the Gulf of Mexico and/or to injection wells. The potable fire, seal and flush water systems at the sites will also be addressed in this portion of the Survey.

4.1 Issue Identification

Based on the documentation supplied by the Strategic Petroleum Reserves Project Management Office as well as the site tour during the pre-Survey site visit, the surface water issues at SPR include brine discharges to the Gulf of Mexico, sewage treatment and stormwater discharges to adjacent surface waters. The issues also include the discharge of aqueous film forming foam (AFFF) used in firefighting, brine disposal line integrity testing, oil and brine spills into waters adjacent to the site, and the acquisition of suitable potable water at Sulphur Mines and Big Hill.

The Survey will include identification of potential discharges to surface waters, which may not be addressed in operating permits or other documents from SPR. The Survey will also assess the potential for contamination (inorganic and organic) of wastewaters. Measures taken to prevent back-flow of non-potable waters into the potable water piping systems will be reviewed. The potential for flooding of the sites also will be reviewed.

A walk-through of the facilities will be made to observe normal routines, including maintenance activities which generate wastewaters. A review will also be made of possible undetected sources of contaminants flowing to the sanitary sewage systems to confirm the findings in SPR Sewage Treatment Plant Analysis (SS86-0003-09). Discharge and monitoring points will be reviewed, and actual sampling procedures will be observed. The adequacy of the monitoring programs and systems will be assessed. The wastewater collection, holding and treatment systems will be examined and records of operations reviewed. The capacity of sewage treatment plants and oil/water (brine) separators will be reviewed. The objective of the review is to build a Survey information base for the identification of physical evidence of existing or potential environmental contamination.

The primary contacts for the surface water specialist will be the site environmental specialists and the site chemists. Interface with operations and/or maintenance personnel at each site will be necessary to discuss preventative maintenance programs for wastewater (brine) treatment facilities, cross connection identification and correction programs, and operations of the water treatment systems at each site.

4.2 Records Required

During the pre-Survey review of documents supplied by SPR, the following additional data and documents were identified as being of interest to the surface water specialist.

- o Discharge Monitoring Reports (DMRs) for each site

- o Analytical Data collected from the stormwater, brine, and wastewater discharges at each site (i.e., data used to compile DMRs and the Annual Environmental Monitoring Reports)
- o Analytical Data from the rawwater, firewater and/or potable water systems at each site
- o Site Operations Manual for Bryan Mound (152-82-BM-001) Sections 4,5.1,5.3,5.4,6.2,8.7,10.3, Appendices A-12,A-13,A-51,A-57,A-58,A-62,A-67,A-70 and A-73
- o Site Operations Manual for Big Hill (D506-012363-08) Section 4
- o Site Operations Manual for Sulphur Mines (152-82-SM-001) Sections 4,5.1,5.3,5.4,7.17,7.18,7.19,8.11,10.3, Appendices G and H
- o Site Operations Manual for West Hackberry (152-82-WH-001) Sections 4,5.1,5.3,5.4,5.6,6.2,6.3,7.24,7.25,7.26,10.3, Appendices A-19,A-23,A-28,A-32,A-33,A-34,A-35,A-36 and A-39
- o Records of residuals (sludge and sediment) disposal from wastewater treatment systems

5.0 GROUNDWATER

The Survey effort will focus on the existence of contamination, its migration potential, and the adequacy of environmental monitoring programs. This effort will involve the evaluation of recent studies of site hydrogeology, determination of the status of on-going studies, assessment of the adequacy of existing monitoring wells, and the review of plans for further investigations, regulatory compliance, and groundwater contamination remedial action.

5.1 Issue Identification

Several areas of specific interest have been identified through the pre-Survey site visit briefings and review of the data received from the Project Management Office and Boeing Petroleum Services. These issues are discussed below.

Groundwater Contamination at West Hackberry

Increases in salinity have been reported for West Hackberry Monitor Well No. PB-1 located adjacent to the brine pond. The water quality from Well PB-1 was very good in 1981 with chlorides reported at 63 mg/l. (For comparison, the secondary drinking water standard for chloride is 250 mg/l). Since that time, analyses indicate the salinity has increased to a chloride level of 122, 547 mg/l on May 21, 1987.

There is a shallow saltwater aquifer at West Hackberry. Well PB-1 monitors a deeper unit (40 to 50 feet below the surface). Leakage from the brine pond would be expected to show up in the shallow aquifer before reaching the deeper unit. However, there were no monitoring wells in the shallow aquifer near the brine pond. Therefore, a geophysical survey (resistivity survey) was performed in the summer of 1987 to determine the depth and location of the plume of high salinity. (Resistivity is the resistance of the geologic medium to the flow of an electrical current, and decreases as groundwater salinity increases.) The results indicated that the plume is in the deeper unit and is centered about the general location of an abandoned cavern (Cavern No. 4). These results suggest that the abandoned wellhead rather than the brine pond could be the source of contamination. The resistivity survey also showed that contamination may exist in both the shallow and deeper aquifer units in an area east of the north insolubles disposal pond. The situation is a probable violation of Louisiana Statewide Order No. 29-B, which prohibits contamination of a groundwater aquifer (defined as groundwater containing less than 10,000 mg/l total dissolved solids) or an underground source of drinking water. New monitoring wells are being installed (or have already been installed) as part of the investigation of the situation. Results, if available, will be examined during the Survey, and an update on the situation will be obtained.

Big Hill Well Contamination

There are twenty-eight wells at the Big Hill SPR site, two for each planned cavern. Eighteen of the wells (nos. 101A-105B and 111A-114B) were drilled by Drillers Incorporated, while the remainder were drilled by Big Chief.

Drillers Incorporated was suspected of having added substances other than clean brine into their wells. The cavern engineering contractor, PB-KBB, sampled some of the wells, and found high viscosity fluids of unusual colors at various points. Qualitative analysis showed a wide variety of mostly long chain hydrocarbon organic constituents present.

Five samples were collected from each well at 1000-foot depth intervals and combined into a composite for analysis, as part of the Phase II CERCLA confirmation investigation. All wells were sampled, including the wells drilled by Big Chief.

Low levels of organic priority pollutants were detected in most of the wells. The compounds were benzene, toluene, ethylbenzene, di-n-butyl phthalate, bis (2-ethylhexyl) phthalate, phenol, methylene chloride, 1,2-dichloroethane, vinyl chloride, isophorone, and n-nitrosodiphenyl amine. Only benzene, toluene, ethylbenzene, and 1,2-dichloroethane were detected in quantities above 0.1 mg/l. None of the levels exceeded the EPA criteria for saltwater.

Unexpected quantities of inorganics were found in the wells. Lead concentrations exceeding 1 mg/l were found in 26 wells, cadmium levels in excess of 1 mg/l were found in three wells, and one well had an elevated mercury level of 4.8 mg/l. Copper levels of up to 111 mg/l, zinc levels of up to 467 mg/l, and cyanide levels of up to 480 mg/l were found. Antimony, nickel, and thallium were found in every well, with most levels exceeding 1 mg/l. Barium, with levels up to 40 mg/l, was found in several of the wells. It should be noted that these are priority pollutant levels, which represent

total concentrations rather than leachate concentrations described by EP toxicity. No set criteria are given by the EPA for priority pollutants. Lead, cadmium, and mercury were found in levels exceeding their EP regulatory thresholds in some of the wells, but due to the difference in extractions, no conclusions can be made as to EP toxicity (Phase II CERCLA Report: Confirmation).

A later report indicated lead contamination at levels of 5 mg/l in Well 108B and 115 mg/l in Well 113B. It is unclear if these analyses were conducted as part of a flush and disposal plan.

As a result of meetings with EPA and the state, the discharge of contents of 23 wells with low levels of contamination been authorized. This discharge would occur from Outfall 001 into the Gulf of Mexico, with the stipulation that brine samples be taken and their composition be reported to the state and EPA. Contents of the other five wells are to be flushed into temporary holding tanks and disposed of appropriately, based on an analysis of their contents. After testing and submission of the residual contents analysis to the state and EPA, these wells may also be leached and their contents discharged from Outfall 001. (Risk Management Report SP 308). Studies have been conducted on effluent mixing in the Gulf of Mexico. These plans will be investigated further during the Survey.

Sole Source Petition for the Chicot Aquifer System

The Chicot aquifer system lies beneath all four of the SPR sites to be investigated during this portion of the on-site Survey. A petition to

designate this aquifer as a sole or principal source of drinking water in southwestern Louisiana was filed with the EPA in December 1986. It is unclear what effect this petition, if granted, would have on SPR operations, since regulations prohibiting any contamination of underground sources of drinking water already exist. However, it would probably result in additional lead time on projects at SPR because of the requirement for EPA review of Federally funded projects in sole source aquifer designated areas.

These matters and others identified prior to or during the on-site portion of the Survey will be discussed with appropriate contacts for the groundwater specialist. These contacts include Melissa Smith (DOE/PMO), Sidney Evans (DOE/PMO), Joyce Teerling (BPS), Bill Bozzo (BPS), and the Site Environmental Specialists for the various sites.

5.2 Records Required

Specific documents and files to be reviewed as part of the Survey include, but will not be limited to, the following:

- o Recent analytical data from groundwater monitoring.
- o Well locations and construction diagrams from new well installation.
- o Well sampling procedures for groundwater monitoring wells. (Well sampling scheduled during the on-site portion of the Survey will be observed.)
- o Work plans for current and proposed groundwater investigations.

6.0 HAZARDOUS/SOLID WASTE

6.1 Issue Identification

The hazardous/solid waste element of the Environmental Survey will identify and record all wastes (hazardous and non-hazardous) generated; document waste storage, recycling and disposal practices; and identify any related problems that could result in the contamination of environmental media. The Survey procedure will involve the following activities:

- o Observe site operations and waste generation;
- o Observe waste management practices and inspect waste management facilities;
- o Interview site personnel regarding waste generation and waste management practices (observed and unobserved);
- o Review waste management files; and
- o Compare on-site observations with SPR procedures and records.

Wastes known to be generated include:

o Drilling muds	o Anhydrites
o Drill cuttings	o Brine

- o Dredge and excavation spoil
- o Construction and demolition debris
- o Spill cleanup material
- o Firefighting foam
- o Waste oil
- o Tank bottoms
- o Nonhazardous industrial waste
- o Nonhazardous municipal waste

Based on information provided and reviewed to date, hazardous wastes are infrequently generated on-site and are disposed of off-site at commercial facilities. EPA has classified the SPR sites as nonhandlers of hazardous wastes.

Waste management facilities include:

- o Drilling mud pits (1 at Bryan Mound and 1 at Sulphur Mines);
- o Drill cutting pond (1 at Big Hill that has been closed);
- o Anhydrite disposal pits (1 at Bryan Mound that has been closed, 1 at Big Hill and 3 at West Hackberry);
- o Brine pits and ponds (1 pit at Bryan Mound, 1 pit at Big Hill, 1 pond at West Hackberry and 2 ponds at Sulphur Mines);
- o Brine disposal wells (4 near Sulphur Mines and 8 near West Hackberry);
and
- o Waste accumulation points and storage areas, including dumpsters.

In addition, aboveground and underground waste tanks (e.g., waste oil tanks) will be surveyed.

Special attention will be paid to waste segregation, waste minimization, and compliance with permit conditions. Other issues to be pursued include:

- o Contamination of cavern brine at Big Hill and corrective action and brine disposal plans;
- o Actions taken to correct the leaking anhydrite pond liner at Big Hill and the effectiveness of the newly installed leak detection system;
- o Groundwater contamination near the West Hackberry brine pond and corrective action plans;
- o Deterioration of pond dikes;
- o Flood protection measures; and
- o Firefighting foam generation and disposal and consideration of possible substitutes.

Discussions will be held with individuals knowledgeable of current and past waste management practices. This will be accomplished during site tours and in the process of reviewing records and documentation. The objective is to develop an understanding of past and existing waste management activities that may serve as the basis for problem identification by the Survey team. The

Waste Management Specialist on the Survey team will interview site personnel, including the site Environmental Specialist and operations personnel (e.g., supervisors of waste management and brine disposal). He will also contact the SPR Environmental Manager, Environmental Coordinator and Environmental Administrator on an as-needed basis. The review of hazardous/solid waste will be coordinated with the inactive waste site, surface water and hydrologic elements of the Survey to identify any possible releases that may pose a threat to the environment.

6.2 Records Required

Records on waste generation and waste management activities will be reviewed while on-site to verify and update documented information. Records include:

- o Brine disposal pipeline integrity reports
- o Waste generator biennial reports
- o Industrial nonhazardous waste quarterly reports
- o Annual waste storage summaries
- o Louisiana Department of Natural Resource Office of Conservation (LOC) manifests, summaries of Texas Waste Commission (TWC) shipping tickets, and manifest quarterly reports
- o Records of on-site disposal activities

- o Tank cleaning and tank bottom transportation authority forms
- o Detailed spill cleanup disposal reports (i.e., where were wastes sent?)

PRELIMINARY

7.0 TOXIC/HAZARDOUS SUBSTANCES

The toxic substances portion of the Environmental Survey will address raw materials and operations-related chemicals used at the various SPR sites as well as the handling, storage and disposal of specific chemicals regulated under the Toxic Substances Control Act (polychlorinated biphenyls (PCBs), chlorofluorocarbons, and asbestos) and the Federal Insecticide, Fungicide and Rodenticide Act (pesticides). The condition and environmental monitoring of underground and above ground storage tanks used for bulk chemical substances other than wastes will also be examined. Through interviews with key SPR personnel and tours of relevant facilities, the tracking, control and management of toxic/hazardous substances will be reviewed. This information and records of usage will be evaluated to identify possible environmental problems through determination of whether or not the systems, equipment and programs established by SPR for the management of toxic/hazardous substances are adequate to minimize, to the extent feasible, potential environmental contamination.

7.1 Issue Identification

The documents that have been submitted to the Environmental Survey for review thus far indicate that with the exception of a transformer at the Sulphur Mines site, all other SPR transformers contain fluid with less than 5 ppm PCB. The site has apparently drained and refilled previously PCB-contaminated transformers with non-PCB oil. In addition, purchase specifications have been established that prohibit the purchase of new transformers that contain PCBs.

During the Environmental Survey, the procedures that have been used by SPR personnel (or SPR contractors) to retrofill transformers will be reviewed. Transformer sampling data that substantiate the claim that no previously-contaminated transformers now contain oils with a PCB concentration in excess of 5 ppm will be requested and evaluated. Any sampling or quality assurance data pertaining to the PCB content of newly-purchased transformers will also be reviewed. Finally, any files that exist with respect to the cleanup of spills involving PCBs (e.g., the 1985 PCB spill at the West Hackberry Site) and any additional information that may be in the possession of SPR regarding the disposal of materials from SPR contaminated with PCBs will be assessed.

SPR has developed a procedure for removing and disposing of asbestos-filled gaskets from pipes. This procedure, "Handling of Asbestos-Filled Gaskets" was issued on January 30, 1986. During the Environmental Survey, any new versions of this procedure that have been prepared will be reviewed. In addition, should the actual removal of an asbestos-filled gasket be scheduled during the Environmental Survey, the opportunity to observe this process is requested. Alternately, if possible, a demonstration of the procedure could be arranged.

Bryan Mound demolished two buildings covered with asbestos siding, one in 1986 and the other in October, 1987. Project files that have been developed for these two demolition projects as well as any others will be requested. These project files should include any information available regarding the disposal of the asbestos-containing material.

Pesticides are used at SPR. During the Environmental Survey, the areas where pesticides are mixed, stored or applied will be inspected. The training program and associated records for SPR employees (and if available, contractor personnel) who work or have worked with pesticides will also be of interest to the team.

Toxic/hazardous chemicals are stored and used in both bulk and smaller quantities at SPR. Areas where toxic/hazardous materials are used and/or stored will be visited during the Survey. Notable in this regard are the locations where above ground and underground storage tanks are present (e.g., the four 8.4 million gallon above ground crude oil storage tanks at Bryan Mound). Procedures covering the purchase, used and storage of toxic/hazardous materials will also be of interest.

The procedures, equipment and programs that have been developed by SPR to comply with 40 CFR 112, "Oil Pollution Prevention" will be thoroughly assessed during the Environmental Survey. The current status of problems that have previously been identified by SPR (e.g., stormwater flooding of cavern pads at West Hackberry and leaking cavern pad dikes at Sulphur Mines) will be determined.

Finally, current copies of the following SPR standard operating procedures will be requested and evaluated during the Environmental Survey: "Inspection and Hazard Abatement" (120P-5); "Regulatory Inspections" (130P-4); and "Unusual Occurrence Reporting (UOR)" (220P-16).

The contact for the toxic/hazardous substances portion of the Survey is the Site Environmental Specialist at the various SPR sites. These contacts are as follows: Jim Salinas (Bryan Mound), David Morris (Big Hill) and Mike Huff (Sulphur Mines and West Hackberry).

7.2 Records Required

Files will be reviewed as part of the Survey, including documents not yet received (e.g., classified documents, individual files, documents not yet identified). Specific documents and files to be collected and reviewed during the Environmental Survey include:

- o Records (including soil analyses for PCBs) covering the disposal of a PCB-contaminated transformer in 1981 from the Bryan Mound site and a 1985 transformer spill at the West Hackberry site.
- o PCB sampling and analysis data for all oil-filled transformers at Bryan Mound, Sulphur Mines, and West Hackberry.
- o Documentation that SPR personnel have conducted site visits at off-site PCB disposal locations.
- o Procedures that are (or have been) used to retrofill transformers that contain fluids contaminated with PCBs and associated sampling data.
- o Latest version of standard procedure 220P-3 "Handling of Asbestos-Filled Gaskets".

- o Project files for demolition of buildings at Bryan Mound covered with asbestos siding in 1986 and 1987.
- o Documentation that the Brazoria County Disposal Corporation is permitted to receive asbestos containing wastes.
- o Any procedures covering the purchase, handling, mixing, application and disposal of pesticides at SPR.
- o Copies of current contracts and/or specifications for contractors who apply pesticides at SPR.
- o Training records for any SPR personnel who handle pesticides.
- o Pesticide application records for 1986 and 1987.
- o Toxic substances labeling and tracking system overview.
- o Procedures for purchasing, handling, storing, using and disposing of toxic substances.
- o Environmental monitoring reports and procedures for underground storage tanks that contain non-waste materials.
- o Unusual Occurrence Reports
- o Internal or external audits of any of the above programs.

- o Project files for demolition of buildings at Bryan Mound covered with asbestos siding in 1986 and 1987.
- o Documentation that the Brazoria County Disposal Corporation is permitted to receive asbestos containing wastes.
- o Any procedures covering the purchase, handling, mixing, application and disposal of pesticides at SPR.
- o Copies of current contracts and/or specifications for contractors who apply pesticides at SPR.
- o Training records for any SPR personnel who handle pesticides.
- o Pesticide application records for 1986 and 1987.
- o Toxic substances labeling and tracking system overview.
- o Procedures for purchasing, handling, storing, using and disposing of toxic substances.
- o Environmental monitoring reports and procedures for underground storage tanks that contain non-waste materials.
- o Unusual Occurrence Reports
- o Internal or external audits of any of the above programs.

- o The following SPR policies or procedures:
 - "Inspection and Hazard Abatement" (120P-5)
 - "Regulatory Inspections" (130P-4)
 - "Unusual Occurrence Reporting" (220P-16)
- o Other records as determined on-site.

PRELIMINARY

8.0 RADIOLOGICAL

The radiological portion of the Survey will involve an assessment of the SPR-wide radioactive sources, controls, monitoring and the related impact on the environment. The Strategic Petroleum Reserves do not process any radioactive materials nor handle any radioactive materials other than sealed sources.

8.1 Issue Identification

Sealed sources of radioactive materials do not generally present a risk of release of radioactivity to the environment unless the sources are damaged or disposed of improperly. A total of 126 Texas Nuclear, SGH Series density gauges are located on pipelines within the Bayou Choctaw, West Hackberry, Sulphur Mines and Bryan Mound sites. Each gauge unit contains between 100 and 400 millicuries of cesium-137. In addition, there are Princeton Gamma Tech Model 100 sulfur analyzers in laboratories at Bayou Choctaw, Bryan Mound, West Hackberry and St. James Marine Terminal. Each analyzer contains approximately 55 millicuries of iron-55.

The sealed sources in both the sulfur analyzers and the density gauges require periodic leak testing to verify that the integrity of the sources is maintained. The Survey team will review source leak test records at each site and, if feasible, inspect the mounting configuration of a representative density gauge at one of the sites.

8.2 Records Required

Additional records that are requested to be available for on-site review include the following:

- o Leak test and other radiological survey data for sealed sources.
- o Records of possession, use, transfer, and/or disposal of radioactive sources.
- o Reports of radiation safety audits conducted by BPS Safety Department.

9.0 QUALITY ASSURANCE

The quality assurance (QA) Survey of the environmental program will be primarily an evaluation of the site sampling and analytical capabilities at SPR. The intent will be to verify and review the quality assurance procedures for obtaining environmental samples, performing the analytical work to identify the concentration of pollutants, and the handling and reporting of data. The quality assurance (QA) Survey activities will consist of an examination of the methods used to assure that the collection and analysis of environmental samples at the SPR sites will result in the generation of valid data.

9.1 Issue Identification

The SPRs conduct monitoring for chemical parameters at NPDES permitted outfalls, fugitive hydrocarbon air emissions, surface water quality and groundwater quality (at selected locations). SPR has established a quality assurance program to support their environmental sampling and analysis efforts. According to SPR documentation, the QA program is based on the U.S. EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories. During the on-site portion of the Survey, the Survey team will review the implementation of this program. The QA Specialist will tour the laboratory facility and review laboratory records and procedures. During the first phase period (November 30 through December 11, 1987), the Survey will include the Bryan Mound and West Hackberry laboratories. The Survey team understands that the Big Hill laboratory is not yet operational. If this understanding is not correct, the Survey team will also review the Big Hill laboratory operations.

Of particular interest to the Survey team are records and procedures related to internal quality assurance analyses, such as method blanks, spikes and duplicates. Techniques used to evaluate the data and correction actions taken to resolve past out-of-control conditions will be examined.

The SPR laboratories participate in the EPA's Discharge Monitoring Report Quality Assurance studies and a SPR program in which blind samples are supplied to the laboratories by the Environmental Control Department. The Survey will review records on the laboratories past performance in these programs.

Equally important is the quality assurance applied to sampling. During the Survey, the QA specialist will review sampling procedures, field notebooks and sample custody records. If possible, arrangements should be made for the Survey team to observe sampling of one or more NPDES discharge points at each site.

The Site Field Chemist should be available for the laboratory tour and during review of QA records.

9.2 Records Required

The following additional records or documents are requested to be available for review during the on-site portion of the Survey:

- o Procedure manuals and quality assurance manuals supporting the sampling and analysis aspects of SPR environmental monitoring.

- o Summaries of internal quality assurance records.
- o Summaries of individual SPR laboratory performance in external performance evaluation programs.
- o Summaries of individual laboratory performance in SPR internal interlaboratory studies.
- o Internal QA audit reports on environmental sampling and analysis.
- o Regulatory agency audit reports on environmental sampling and analysis.
- o Sample custody records.
- o Laboratory notebooks.
- o Instrument calibration and maintenance records.

10.0 INACTIVE WASTE SITES/RELEASES (CERCLA)

This aspect of the Survey will be coordinated primarily with the Hazardous/Solid Waste and Hydrogeology team members, and will focus on identifying environmental problems related to past waste disposal practices, past spills and releases; and the potential for current and future releases from such historical sites/events.

10.1 Issue Identification

The Survey will identify and inventory any existing and potential environmental problems and threats to the environment resulting from the past handling, storage, and disposal of waste substances. This will be accomplished through investigations and analysis of the following:

- o Inactive waste handling, storage, and disposal sites, and releases prior to Department of Energy (DOE) acquisition of the property;
- o Inactive waste handling, storage, and disposal sites, and releases while under DOE purview;
- o Current practices for handling, storing, and disposing of wastes; and
- o The potential for future uncontrolled spills or releases on SPR lands.

Areas of the SPR sites that are suspected of having been used or known to have been used for purposes involving wastes, including hazardous substances, prior to DOE acquisition, will be inspected and assessed. These sites include:

- o Big Hill where various Amoco facilities were located (e.g., brine disposal well, tank, mud pit);
- o Bryan Mound where two municipal landfills were operated as well as sulphur brine production areas; and
- o Sulphur Mines where sulphur production areas were once active.

Areas of the SPR sites where wastes are suspected to have been or known to have been handled, subsequent to DOE acquisition will be inspected and assessed. These sites include:

- o Big Hill where wells have been identified as having been contaminated with hazardous substances or have been used for the disposal of spilled oil during SPR drilling operations;
- o Bryan Mound where a well blow out occurred (1978, sulfide and methane release); and where there is located an abandoned surface impoundment, a cement-stabilized mud pit (possible chromium contamination), and two caverns that are contaminated with asbestos;
- o Sulphur Mines where there are mud pits with possible chromium contamination, and possible radioactive tracer pellets; and
- o West Hackberry where there were spills, including Well Pad 6.

In addition to these identified areas, inactive tanks, piping systems, containers, and storage areas that may have held wastes will be inspected and their status assessed. Other activities, including dust control, brine disposal, and mud disposal, will also be examined. If drilling muds have been disposed of off-site, we will want to know the location of the disposal sites and available information on the types and quantities of muds disposed of.

The Survey team will want to review available material pertaining to the CERCLA Phase I Installation Report (i.e., map locations of all burial, spill, and release sites, abandoned wells, personnel interview files and HRS evaluations) and the Phase II Confirmation Report (i.e., depths of samples, and sample locations).

The team will also want to review the environmental records pertaining to past management, disposal, clean-up, and regulatory compliance regarding wastes. Project design and analytical data in support of site cleanup (remediation) will also be reviewed. The team will also review available engineering drawings of product and waste management facilities.

Lastly, the Survey team would, if possible, like to meet on-site with a representative(s) of former property owner(s) (e.g., Amoco, Dow) as appropriate to discuss the historical use of the various properties (i.e., preceding DOE acquisition).

Primary contacts for this portion of the Survey will include personnel from Operations and Maintenance, Site Environmental Specialists, and Site Safety Administrator.

10.2 Records Required

The following records, among others, will be reviewed at the site:

- o Standard Operating Procedures regarding management of hazardous substances, disposal areas, and storage areas.
- o Hazardous substances inventories.
- o Historical files on past operations and processes, substances used, and methods of handling and disposal.
- o Records of facility expansion.
- o Records of regulatory notification pertaining to inactive waste sites and potential areas of contamination (e.g., CERCLA 103(c)).
- o Spill Reporting Procedures Manual.
- o Description of former waste management facilities, including inactive buried tanks and structures.
- o A map showing the location of each of the known inactive and release spill sites.
- o "Interview files", if relevant, for the CERCLA Phase 1 report.

- o Engineering drawings of waste management facilities.
- o Documents pertaining to known or suspected off-site contamination associated with SPR (e.g., mud disposal).
- o Documents pertaining to past remedial actions.
- o Environmental records pertaining to past facility responses to hazardous substance spills and releases.
- o Aerial photographs of SPR sites (historical).

AIR EMISSIONS AND AIR QUALITY - T. ECKLE

MONDAY, NOV. 30	TUESDAY, DEC. 1	WEDNESDAY, DEC. 2	THURSDAY, DEC. 3	FRIDAY, DEC. 4
<p><u>Bryan Mound</u> 8 AM-Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-4-Discuss Air Issues w/Site Environmental Specialist 4-5-Develop Findings 5-Team Meeting</p>	<p><u>Bryan Mound</u> 8-12-Review Requested Additional Documents 12-1-Lunch 1-2-Observe Monitoring of Fugitive VOC 2-5-Develop Findings 5-Team Meeting</p>	<p><u>Bryan Mound</u> 8-11-Finalize Findings 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas</p>	<p>8 AM-Environmental Safety/Security Briefing 9:30-12:30-Tour 12:30-1:00-Lunch 3-4-Discuss Air Issues w/Site Environment Specialist 4-5-Develop Findings 5-Team Meeting 3-Reality Check 4:30-Exit Meeting</p>	<p><u>Big Hill</u> 8-12-Review Requested Additional Documents 1-3-Finalize Findings</p>
MONDAY, DEC. 7	TUESDAY, DEC. 8	WEDNESDAY, DEC. 9	THURSDAY, DEC. 10	FRIDAY, DEC. 11
<p><u>Sulphur Mines</u> 8-Environmental Safety/Security Briefing 9:30-12:30-Tour 12:30-1:30-Lunch 3-4-Discuss Air Issues w/Site Environmental Specialist 4-5-Develop Findings 5-Team Meeting</p>	<p><u>Sulphur Mines</u> 8-12-Review Requested Additional Documents 1-3-Develop Findings 3-Reality Check 4:30-Exit Meeting 5-Team Meeting</p>	<p>8-Environmental Safety/Security Briefing 9:30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour 2-3-Discuss Air Issues w/Site Environmental Specialist 3-5-Develop Findings 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-10-Review Requested Additional Documents 10-12-Observe VOC Emission Monitoring 1-5-Develop Findings and S&A Requests 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for airport</p>

SURFACE WATER - R. TARBERT

MONDAY, NOV. 30	TUESDAY, DEC. 1	WEDNESDAY, DEC. 2	THURSDAY, DEC. 3	FRIDAY, DEC. 4
<u>Bryan Mound</u> 8 AM-Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Review Analytical Data & Operations Manual 5-Team Meeting	<u>Bryan Mound</u> 8-NPDES Sampling 11-Q&A Site Environmental Specialist 1-Operations/Maintenance-Preventative Maintenance Cross Connections & Integrity Testing 5-Team Meeting	<u>Bryan Mound</u> 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas	8 AM-Environmental Safety/Security Briefings 9:30-12:30-Tour 12:30-1:00-Lunch 1-Review Analytical Data & Operations Manual 5-Team Meeting	<u>Big Hill</u> 8-NPDES Sampling 10-Operations/Maintenance-Preventative Maintenance Cross Connections & Integrity Testing 1-Q&A Site Env. Spec. 3-Reality Check 4:30-Exit Meeting
MONDAY, DEC. 7	TUESDAY, DEC. 8	WEDNESDAY, DEC. 9	THURSDAY, DEC. 10	FRIDAY, DEC. 11
<u>Sulphur Mines</u> 8-Environmental Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Review Analytical Data & Operations Manual 5-Team Meeting	<u>Sulphur Mines</u> 8-NPDES Sampling 10-Operations/Maintenance-Preventative Maintenance Cross Connections & Integrity Testing 1-Q&A Site Env. Spec. 3-Reality Check 4:30-Exit Meeting 5-Team Meeting	8-Environmental Safety/Security Briefings 9:30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour 2-Review Analytical Data & Operations Manual 5-Team Meeting	<u>West Hackberry</u> 8-NPDES Sampling 10-Operations/Maintenance-Preventative Maintenance Cross Connections & Integrity Testing 1-Q&A Site Env. Spec. 5-Team Meeting	<u>West Hackberry</u> 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for airport

MONDAY, NOV. 30	TUESDAY, DEC. 1	WEDNESDAY, DEC. 2	THURSDAY, DEC. 3	FRIDAY, DEC. 4
<u>Bryan Mound</u> 8 AM-Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour Start File Review 5-Team Meeting	<u>Bryan Mound</u> 8-NPDES Sampling 10-QA with Site Enviro. Spec. Interview other site personnel & continue file review 5-Team Meeting	<u>Bryan Mound</u> 8-Complete inter-views & file reviews 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas	<u>Big Hill</u> 8 AM-Environmental Safety/Security Briefings 9:30-12:30-Tour 12:30-1:00-Lunch Interview Site Personnel & Review Files 5-Team Meeting	<u>Big Hill</u> 8-NPDES Sampling 10-QA with Site Enviro. Spec. Complete interviews & File Reviews 3-Reality Check 4:30-Exit Meeting
MONDAY, DEC. 7	TUESDAY, DEC. 8	WEDNESDAY, DEC. 9	THURSDAY, DEC. 10	FRIDAY, DEC. 11
<u>Sulphur Mines</u> 8-Environmental Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch Interview Site Personnel & Review Files 5-Team Meeting	<u>Sulphur Mines</u> 9-QA with Site Enviro. Spec. Continue interviews & file reviews 3-Reality Check 4:30-Exit Meeting 5-Team Meeting	8-Environmental Safety/Security Briefings 9:30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour Start File Review 4-QA with Site Enviro. Spec. 5-Team Meeting	<u>West Hackberry</u> 8-NPDES Sampling Interview Site Personnel & Review Files 5-Team Meeting	<u>West Hackberry</u> 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for airport

HYDROGEOLOGY - M. ROBISON

MONDAY, NOV. 30	TUESDAY, DEC. 1	WEDNESDAY, DEC. 2	THURSDAY, DEC. 3	FRIDAY, DEC. 4
<u>Bryan Mound</u> 8 AM Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 4-CERCLA Q&A 5-Team Meeting	<u>Bryan Mound</u> 8-Inactive Sites Tour 10-Observe any Well Sampling being conducted 1-Records Review & Discussions w/S. Evans or BPS personnel as required 5-Team Meeting	<u>Bryan Mound</u> 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas	<u>Big Hill</u> 8 AM-Environmental Safety/Security Briefings 9:30-12:30-Tour 12:30-1:00-Lunch 1-Inactive Sites Tour 3-Discussion w/M. Smith or S. Evans on Status of Well Contamination Problem 4-CERCLA Q&A 5-Team Meeting	<u>Big Hill</u> 8-Observe any Well Sampling being conducted 10-Records Review & Discussions w/S. Evans or BPS personnel as required 3-Reality Check 4:30-Exit Meeting
MONDAY, DEC. 7	TUESDAY, DEC. 8	WEDNESDAY, DEC. 9	THURSDAY, DEC. 10	FRIDAY, DEC. 11
<u>Sulphur Mines</u> 8-Environmental Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Inactive Sites Tour 4-CERCLA Q&A 5-Team Meeting	<u>Sulphur Mines</u> 8-Records Review & Discussions w/S. Evans or BPS personnel as required 3-Reality Check 4:30-Exit Meeting 5-Team Meeting	<u>West Hackberry</u> 8-Environmental Safety/Security Briefings 9:30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour 2-Records for New Well 3-CERCLA Q&A 5-Team Meeting	<u>West Hackberry</u> 8-Inactive Sites Tour 10-Observe any Well Sampling being conducted 1-Records Review & Discussions w/S. Evans or BPS personnel as required 5-Team Meeting	<u>West Hackberry</u> 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for airport

TOXIC/HAZARDOUS SUBSTANCES - R. GERLACH

MONDAY, NOV. 30	TUESDAY, DEC. 1	WEDNESDAY, DEC. 2	THURSDAY, DEC. 3	FRIDAY, DEC. 4
<p>Bryan Mound</p> <p>8 AM-Badging, Environmental Safety/Security Briefings</p> <p>10-12-Tour</p> <p>12-1-Lunch</p> <p>1-3-Tour</p> <p>3-Review Files Related to PCB Issues at Bryan Mound</p> <p>5-Team Meeting</p>	<p>Bryan Mound</p> <p>8-NPDES Sampling</p> <p>10-Review pesticide & asbestos-related files</p> <p>1-Meet w/Bryan Mound Site Environmental Specialist</p> <p>2-Review files on demolition of bldgs covered w/alum. siding</p> <p>3-Ubserve asbestos gasket removal proc.</p> <p>4-Review files</p> <p>5-Team Meeting</p>	<p>Bryan Mound</p> <p>11-Reality Check</p> <p>2-Resolve Questions</p> <p>4-Exit Meeting</p> <p>5-Leave for Beaumont, Texas</p>	<p>Big Hill</p> <p>8 AM-Environmental Safety/Security Briefings</p> <p>9:30-12:30-Tour</p> <p>12:30-1:00-Lunch</p> <p>1-Review Files Related to PCB Issues at Big Hill</p> <p>3-Review Files on Purchase & Storage of Toxic/Hazardous Materials at Big Hill</p> <p>5-Team Meeting</p>	<p>Big Hill</p> <p>8-NPDES Sampling</p> <p>11-Meet w/Big Hill Site Environmental Specialist</p> <p>1-Review pesticide-and asbestos-related files</p> <p>3-Reality Check</p> <p>4:30-Exit Meeting</p>
MONDAY, DEC. 7	TUESDAY, DEC. 8	WEDNESDAY, DEC. 9	THURSDAY, DEC. 10	FRIDAY, DEC. 11
<p>Sulphur Mines</p> <p>8-Environmental Safety/Security Briefings</p> <p>9:30-12:30-Tour</p> <p>12:30-1:30-Lunch</p> <p>1:30-Review Files Related to PCB Issues at Sulphur Mines</p> <p>3-Review Pesticide & Asbestos-Related Files</p> <p>5-Team Meeting</p>	<p>Sulphur Mines</p> <p>8-NPDES Sampling</p> <p>10-Review files on purchase & storage of toxic/haz. materials at Sulphur Mines</p> <p>11-Meet w/Sulphur Mines Site Environmental Specialist</p> <p>3-Reality Check</p> <p>4:30-Exit Meeting</p> <p>5-Team Meeting</p>	<p>West Hackberry</p> <p>8-Environmental Safety/Security Briefings</p> <p>9:30-12:00-Tour</p> <p>12:00-12:30-Lunch</p> <p>12:30-2:00-Tour</p> <p>2-Review Files Related to PCB Issues at West Hackberry</p> <p>5-Team Meeting</p>	<p>West Hackberry</p> <p>8-NPDES Sampling</p> <p>10-Review pesticide & asbestos-related files</p> <p>11-Meet with West Hackberry Site Environmental Specialist</p> <p>1-Review files on purchase & storage of toxic/haz. materials at West Hackberry</p> <p>5-Team Meeting</p>	<p>West Hackberry</p> <p>8-Reality Check</p> <p>10-12-Resolve Questions</p> <p>12-1-Lunch</p> <p>1-3-Close-out</p> <p>3-Leave for airport</p>

QA/RADIATION/TECHNICAL COORDINATION - D. YESSO

MONDAY, NOV. 30	TUESDAY, DEC. 1	WEDNESDAY, DEC. 2	THURSDAY, DEC. 3	FRIDAY, DEC. 4
<p><u>Bryan Mound</u></p> <p>8 AM-Badging, Environmental Safety/Security Briefings</p> <p>10-12-Tour</p> <p>12-1-Lunch</p> <p>1-3-Tour</p> <p>3-4-Review Source Leak Test Records</p> <p>4-5-Review QA/Lab Procedures</p> <p>5-Team Meeting</p>	<p><u>Bryan Mound</u></p> <p>8-Observe NPDES Sampling</p> <p>9-Tour laboratory (Field Chemist)</p> <p>10-12-Review QA Records (Field Chemist)</p> <p>12-1-Lunch</p> <p>11-5-Technical Coordination</p> <p>5-Team Meeting</p>	<p><u>Bryan Mound</u></p> <p>8-11-Technical Coordination</p> <p>11-Reality Check</p> <p>11-2-Technical Coordination</p> <p>2-Resolve Questions</p> <p>4-Exit Meeting</p> <p>5-Leave for Beaumont, Texas</p>	<p><u>Big Hill</u></p> <p>8 AM-Environmental Safety/Security Briefings</p> <p>9:30-12:30-Tour</p> <p>12:30-1:00-Lunch</p> <p>1-5-Technical Coordination/Review QA Records</p> <p>5-Team Meeting</p>	<p><u>Big Hill</u></p> <p>8-NPDES Sampling</p> <p>9-10-Tour laboratory (Field Chemist)</p> <p>10-12-Review QA Records (Field Chemist)</p> <p>12-3-Technical Coordination</p> <p>3-Reality Check</p> <p>4:30-Exit Meeting</p>
MONDAY, DEC. 7	TUESDAY, DEC. 8	WEDNESDAY, DEC. 9	THURSDAY, DEC. 10	FRIDAY, DEC. 11
<p><u>Sulphur Mines</u></p> <p>8-Environmental Safety/Security Briefings</p> <p>9:30-12:30-Tour</p> <p>12:30-1:30-Lunch</p> <p>1:30-2:30-Review Source Leak Test Records</p> <p>2:30-5-Technical Coordination</p> <p>5-Team Meeting</p>	<p><u>Sulphur Mines</u></p> <p>8-9-Observe NPDES Sampling</p> <p>9-11-Review QA Records</p> <p>11-12-Technical Coordination</p> <p>12-1-Lunch</p> <p>1-3-Technical Coordination</p> <p>3-Reality Check</p> <p>4:30-Exit Meeting</p> <p>5-Team Meeting</p>	<p><u>West Hackberry</u></p> <p>8-Environmental Safety/Security Briefings</p> <p>9:30-12:00-Tour</p> <p>12:00-12:30-Lunch</p> <p>12:30-2:00-Tour</p> <p>2-3-Review Source Leak Test Records</p> <p>3-5-Review QA/Lab Procedures</p> <p>5-Team Meeting</p>	<p><u>West Hackberry</u></p> <p>8-NPDES Sampling</p> <p>9-10-Tour Laboratory (Field Chemist)</p> <p>10-12-Review QA Records (Field Chemists)</p> <p>12-1-Lunch</p> <p>1-5-Technical Coordination</p> <p>5-Team Meeting</p>	<p><u>West Hackberry</u></p> <p>8-Reality Check</p> <p>10-12-Resolve Questions</p> <p>12-1-Lunch</p> <p>1-3-Close-out</p> <p>3-Leave for airport</p>

CERCLA - R. SCULLIN/D. OUDERKIRK

MONDAY, NOV. 30	TUESDAY, DEC. 1	WEDNESDAY, DEC. 2	THURSDAY, DEC. 3	FRIDAY, DEC. 4
<u>Bryan Mound</u> 8 AM-Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Review Environ. Files 4-CERCLA QA 5-Team Meeting	<u>Bryan Mound</u> 8-CERCLA Tour 11-Review Environ. Files 1-Interview Staff (incl. former party owner personal), Review Environ. Files 5-Team Meeting	<u>Bryan Mound</u> 8-Complete File Review & Interviews 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas	<u>Big Hill</u> 8 AM-Environmental Safety/Security Briefing 9:30-12:30-Tour 12:30-1:00-Lunch 1-CERCLA Tour 4-CERCLA QA 5-Team Meeting	<u>Big Hill</u> 8-Review Environ. Files, Conduct Staff Interviews (incl. former party owner personal) 1-Determine S&A Needs 3-Reality Check 4:30-Exit Briefings
MONDAY, DEC. 7	TUESDAY, DEC. 8	WEDNESDAY, DEC. 9	THURSDAY, DEC. 10	FRIDAY, DEC. 11
<u>Sulphur Mines</u> 8 AM-Environmental Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Inactive Sites Tour 5-Team Meeting	<u>Sulphur Mines</u> 8-Review Environ. Files 10-CERCLA QA 11-Interview Staff (incl. former party owner personal) 3-Reality Check 4:30-Exit Meeting 5-Team Meeting	<u>West Hackberry</u> 8-Environmental Safety/Security Briefings 9:30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour 2-Review Environ. Files 3-CERCLA QA 5-Team Meeting	<u>West Hackberry</u> 8-CERCLA Tour 10-Review Environ. Files, Conduct Staff Interviews (incl. former party owner personal) 1-Complete Environ. Review 5-Team Meeting	<u>West Hackberry</u> 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport

TABLE 2-2
STRATEGIC PETROLEUM RESERVE
SUMMARY SITE - SURVEY AGENDA
NOVEMBER 30 - DECEMBER 11, 1987

HYDROGEOLOGY

	AIR	WATER	SOIL	CERCLA	HAZ/SOLID WASTE	TSCA	QA/QAD
MONDAY, NOV. 30	Bryan Mound 8 AM-Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-4-Discuss Air Issues w/Site Environmental Specialist 4-5-Develop Findings 5-Team Meeting	Bryan Mound 8 AM-Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Review Analytical Data & Operations Manual 5-Team Meeting	Bryan Mound 8 AM-Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Review Environ. Files 4-CERCLA QA 5-Team Meeting	Bryan Mound 8 AM-Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour Start File Review 5-Team Meeting	Bryan Mound 8 AM-Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Review Files Related to PCB Issues at Bryan Mound 5-Team Meeting	Bryan Mound 8 AM-Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-4-Review Source Leak Test Records 4-5-Review QA/Lab Procedures 5-Team Meeting	Bryan Mound 8 AM-Badging, Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-4-Review Source Leak Test Records 4-5-Review QA/Lab Procedures 5-Team Meeting
TUESDAY, DEC. 1	Bryan Mound 8-12-Review Requested Additional Documents 12-1-Lunch 1-2-Observe Monitoring of Fugitive VOC 2-5-Develop Findings 5-Team Meeting	Bryan Mound 8-12-Review Requested Additional Documents 12-1-Lunch 1-2-Observe Monitoring of Fugitive VOC 2-5-Develop Findings 5-Team Meeting	Bryan Mound 8-12-Review Requested Additional Documents 12-1-Lunch 1-2-Observe Monitoring of Fugitive VOC 2-5-Develop Findings 5-Team Meeting	Bryan Mound 8-12-Review Requested Additional Documents 12-1-Lunch 1-2-Observe Monitoring of Fugitive VOC 2-5-Develop Findings 5-Team Meeting	Bryan Mound 8-12-Review Requested Additional Documents 12-1-Lunch 1-2-Observe Monitoring of Fugitive VOC 2-5-Develop Findings 5-Team Meeting	Bryan Mound 8-12-Review Requested Additional Documents 12-1-Lunch 1-2-Observe Monitoring of Fugitive VOC 2-5-Develop Findings 5-Team Meeting	Bryan Mound 8-12-Review Requested Additional Documents 12-1-Lunch 1-2-Observe Monitoring of Fugitive VOC 2-5-Develop Findings 5-Team Meeting
WEDNESDAY, DEC. 2	Bryan Mound 8 11-Finalize Findings 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas	Bryan Mound 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas	Bryan Mound 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas	Bryan Mound 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas	Bryan Mound 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas	Bryan Mound 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas	Bryan Mound 11-Reality Check 2-Resolve Questions 4-Exit Meeting 5-Leave for Beaumont, Texas

TABLE 2-2

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TABLE 2-2
STRATEGIC PETROLEUM RESERVE
SUMMARY SITE - SURVEY AGENDA
NOVEMBER 30 - DECEMBER 11, 1987

HYDROGEOLOGY

AIR	WATER	SOIL	CERCLA	HAZ/SOLID WASTE	TSCA	QA/RAD
<p><u>Sulphur Mines</u> 8-12-Review Re- quested Additional Documents</p> <p>1-3-Develop Findings 3-Reality Check 4-30-Exit Meeting 5-Team Meeting</p>	<p><u>Sulphur Mines</u> 8-BPDES Sampling 10-Operations/Main- tenance-Preven- tive Maintenance Cross Connections & Integrity Testing 1-QA Site Env. Spec. 3-Reality Check 4-30-Exit Meeting 5-Team Meeting</p>	<p><u>Sulphur Mines</u> 8-Records Review & Discussions w/S. Evans or BPS personnel as re- quired</p> <p>3-Reality Check 4-30-Exit Meeting 5-Team Meeting</p>	<p><u>Sulphur Mines</u> 8-Review Environ. Files 10-CERCLA QA 11-Interview Staff (incl. former pro- perty owner per- sonnel) 3-Reality Check 4-30-Exit Meeting 5-Team Meeting</p>	<p><u>Sulphur Mines</u> 9-QA with Site Enviro. Spec. Continue Interviews & file reviews 3-Reality Check 4-30-Exit Meeting 5-Team Meeting</p>	<p><u>Sulphur Mines</u> 8-BPDES Sampling 10-Review files on purchase & storage of toxic/haz materials at Sulphur Mines 11-Meet w/Sulphur Mines Site Environmental Specialist 3-Reality Check 4-30-Exit Meeting 5-Team Meeting</p>	<p><u>Sulphur Mines</u> 8-9-Observe BPDES Sampling 9-11-Review QA Records 11-12-Technical Co- ordination 12-1-Lunch 1-3-Technical Co- ordination 3-Reality Check 4-30-Exit Meeting 5-Team Meeting</p>
<p><u>West Hackberry</u> 8-Environmental Safety/Security Briefing 9-30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour 2-3-Discuss Air is- sues w/Site Environmental Specialist 3-5-Develop Findings 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-Environmental Safety/Security Briefings 9-30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour 2-Review Analytical Data & Operations Manual 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-Environmental Safety/Security Briefings 9-30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour 2-Records for Web Mail 3-CERCLA QA 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-Environmental Safety/Security Briefings 9-30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour 2-Review Environ. Files 3-CERCLA QA 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-Environmental Safety/Security Briefings 9-30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour 2-Review Files re- lated to PCB is- sues at West Hackberry 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-Environmental Safety/Security Briefings 9-30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour 2-Review Files re- lated to PCB is- sues at West Hackberry 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-Environmental Safety/Security Briefings 9-30-12:00-Tour 12:00-12:30-Lunch 12:30-2:00-Tour 2-3-Review Source Leak Test Records 3-5-Review QA/Lab Procedures 5-Team Meeting</p>
<p><u>West Hackberry</u> 8-BPDES Sampling 10-12-Review Re- quested Additional Documents 10-12-Observe VOC Emission Monitoring 1-5-Develop Findings and SAA Requests 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-BPDES Sampling 10-Operations/Main- tenance-Preven- tive Maintenance Cross Connections & Integrity Testing 1-QA Site Env. Spec. 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-Inactive Sites Tour 10-Observe any Well Sampling being con- ducted 1-Records Review & Discussions w/S. Evans or BPS per- sonnel as required 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-CERCLA Tour 10-Review Environ. Files, Conduct SCoiff Interviews (incl. former pro- perty owner per- sonal) 1-Complete Environ. Review 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-BPDES Sampling 10-Review pesticide & asbestos-related files 11-Meet with West Hackberry Site Environmental Specialist 1-Review files on purchase & storage of toxic/haz. materials at West Hackberry 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-BPDES Sampling 10-Review pesticide files 11-Meet with West Hackberry Site Environmental Specialist 1-Review files on purchase & storage of toxic/haz. materials at West Hackberry 5-Team Meeting</p>	<p><u>West Hackberry</u> 8-BPDES Sampling 9-10-Tour Laboratory (Field Chemist) 10-12-Review QA Records (Field Chemists) 12-1-Lunch 1-5-Technical Co- ordination 5-Team Meeting</p>

TABLE 2-2
STRATEGIC PETROLEUM RESERVE
SUMMARY SITE - SURVEY AGENDA
NOVEMBER 30 - DECEMBER 11, 1987

	HYDROGEOLOGY						QA/RAD
	AIR	WATER	SOIL	CERCLA	HAZ/SOLID WASTE	TSCA	
FRIDAY, DEC. 11	West Hackberry 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for airport	West Hackberry 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for airport	West Hackberry 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for airport	West Hackberry 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport	West Hackberry 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for airport	West Hackberry 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for airport	West Hackberry 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for airport

STRATEGIC PETROLEUM RESERVE
ENVIRONMENTAL SURVEY PLAN
PHASE II

U.S. Department of Energy

Environment, Safety and Health Office of Environmental Audit

Strategic Petroleum Reserve Environmental Survey Plan Phase II

February 1 - 10, 1988

ENVIRONMENTAL SURVEY PLAN
STRATEGIC PETROLEUM RESERVE
WEEKS ISLAND, IBERIA PARISH, LA
BAYOU CHOCTAW, IBERVILLE PARISH, LA
ST. JAMES MARINE TERMINAL, ST. JAMES PARISH, LA
FEBRUARY 1 - 11, 1988

1.0 INTRODUCTION

The Strategic Petroleum Reserve (SPR) Environmental Survey is part of the larger Department of Energy (DOE)-wide Environmental Survey effort announced by Secretary John S. Herrington on September 18, 1985. The purpose of this effort is to inventory, via "no fault" baseline Surveys, existing environmental problems and areas of environmental risk at DOE facilities, and to rank them on a DOE-wide basis. This ranking will enable DOE to more effectively establish priorities for addressing environmental problems and allocate the resources necessary to correct these problems. Because the Survey is "no fault" and is not an "audit", it is not designed to identify specific isolated incidents of noncompliance, or to analyze environmental management practices. Such incidents and/or management practices will, however, be used in the Survey as a means of identifying existing and potential environmental problems.

The SPR Survey will be conducted in accordance with the protocols and procedures contained in the Environmental Survey Manual, August 1987.

2.0 SURVEY IMPLEMENTATION

The Environmental Survey of the Strategic Petroleum Reserve (SPR) will be managed by the DOE Team Leader, Thomas Traceski and the Assistant Team Leader, Donna Bergman. Sidney Evans from the SPR Project Management Office (PMO) will serve as the designated Operations Office representative on the Environmental Survey Team. Technical support is provided by NUS Corporation and ICF Corporation personnel as follows:

Richard Tarbert	NUS Coordinator/Surface Water
David Yesso	Assistant NUS Coordinator/Radiation/QA
Richard Gerlach	TSCA (Toxic Materials)
Tom Eckle	Air
Gerard Kelly	RCRA/Solid Waste/Inactive Sites
Mary Robison	Hydrogeology/Soil

2.1 Pre-Survey Activities

Pre-Survey activities began in August, 1987, when the DOE Team Leader and Assistant Team Leader initiated reviews of SPR environmental documents that were available at the DOE Office of Environmental Audit (OEV). This review was followed by a September 1, 1987, memorandum from OEV to the Oak Ridge Operations Office (ORO) and the Strategic Petroleum Reserve announcing a pre-Survey site visit and requesting additional Survey-related information. The technical specialists began their review of the documents available at OEV in September 1987. The purpose of the review of that material was to allow the Survey team members to gain familiarity with SPR and prepare themselves for the pre-Survey site visit.

Four members of the Survey team, Thomas Traceski, Donna Bergman, David Yesso, and Mary Robison, conducted the pre-Survey site visit on October 13 through 15, 1987. The visit was scheduled to allow team members an opportunity to gain initial familiarity with a representative SPR site, identify potential areas of environmental concern, explain the objectives and methodology of the Survey, collect and review the documents requested in the September 1, 1987 memorandum, and coordinate plans for the upcoming Survey with DOE/ORO, DOE/SPR-PMO, and the operating contractor Boeing Petroleum Services (BPS). Mr. Maury Walsh, Battelle, Columbus Division, who will coordinate the sampling and analysis phase of the Survey, also attended the pre-Survey site visit.

During the pre-Survey site visit, team members were provided with detailed briefings by BPS and DOE/SPR-PMO personnel on the SPR organization, operations, and activities; environmental issues; site security; safety; industrial hygiene; and the plant environmental programs. Of particular value to the team was the tour of Bayou Choctaw, a representative SPR site. Following the briefings provided on October 13, 1987, team members had an opportunity to review the environmental documents that had been assembled by SPR-PMO and BPS personnel. Based upon this review, the briefings, and the tour, a limited number of additional documents were identified and requested by team members. Arrangements were made to have the collected materials shipped to the NUS offices in Pittsburgh. All of the documents that were requested in the memorandum of September 1, 1987, and during the pre-Survey site visit have been received. This Survey plan is based upon material received by the Survey team through the end of October 1987.

In conjunction with the pre Survey site visit, Messrs. Traceski and Yesso, and Ms. Bergman, of the Survey team, along with Sidney Evans (DOE/SPR-PMO) and William Bozzo (BPS) met, in separate meetings, with officials from the U.S. EPA, Region VI, the State of Louisiana, and the State of Texas. These meetings were scheduled to explain the purposes of the Survey to personnel from the cognizant Federal and state regulatory agencies and to allow them to express their concerns over the environmental conditions of the SPR sites.

2.2 On-Site Activities and Reports

The on-site portion of the Environmental Survey will be conducted in two phases. The first phase, conducted during the two week period November 30 through December 11, 1987, included the four westernmost sites in the Seaway and Texoma Systems: Big Hill, Bryan Mound, West Hackberry, and Sulfur Mines. The second phase, to be conducted during the two week period from February 1 through February 11, 1988, will include the three sites in the Capline System: Bayou Choctaw, Weeks Island, and the St. James Marine Terminal. A brief introductory meeting will be held on the team's first morning at each site. The purpose of these meetings is two-fold: First, introduce the Survey team to the management and environmental personnel at each site and to briefly review the objectives of the Survey; and second, these meetings will provide the Survey team with safety and security briefings by site personnel as well as a site-specific overview of the environmental program at each SPR location. A detailed site tour will follow the briefings. The Survey team requests that at each site, the site Environmental Specialist, site Field Chemist, an operations representative, and a maintenance representative be present for the duration of each tour to answer questions. The Survey team expects that the tours will require approximately four hours at each site.

Since only the Quality Assurance Specialist requires a tour of laboratory facilities, they should not be included in the initial site tour, but scheduled separately. The Survey will include consideration of all facilities and areas associated with the Strategic Petroleum Reserves.

A tentative Survey agenda is shown in Table 2-1 and a summary of the agenda is included as Table 2-2. As members of the Survey team continue their review of site documents, and gain information during the site visit, it is anticipated that modifications to the agenda will be needed to minimize disruption of site activities as well as to optimize the efficiency and effectiveness of the Survey. All modifications will be coordinated through the SPR-PMO and BPS personnel designated as Survey contacts.

The on-site activities of the Survey team will consist of interviews and consultations with, among others, environmental, industrial hygiene, safety, operations, maintenance, waste management, purchasing, and warehousing personnel; a review of files and documents unavailable to the team prior to the on-site portion of the Survey; technical-specialty-specific tours of limited areas of the site.

At the conclusion of the team's visit to each site, the Survey team will hold technical accuracy meetings (reality check) with the site personnel. These meetings will include a presentation of the preliminary findings to site technical personnel to verify that the Survey team's understanding of an issue is correct and that there is no additional information on the subject that the team should consider. If site personnel identify issues requiring follow-up,

this will be accomplished as soon as possible, following the meeting. In addition, the DOE Team Leader and Assistant Team Leader will be available for a brief exit meeting with site management prior to departure. A formal closeout briefing will be conducted on Wednesday, February 10, 1988 at the SPR-PMO in New Orleans, Louisiana to describe preliminary findings of the entire two-week on-site activities.

A Survey status report will be prepared within 2 weeks after the conclusion of each on-site portion of the Survey. A Preliminary Report of the overall Survey (Phases One & Two) will be prepared within 14 to 16 weeks from the conclusion of the on-site Survey activities. Public distribution of the Preliminary Report will be at the discretion of the Oak Ridge Operations Office and the SPR-PMO although copies will be made available to members of Congress and EPA Headquarters, upon request. Subsequently, an Interim Report will be prepared by the Survey team within 6 to 8 weeks of the completion of sample analysis. The Interim Report will incorporate PMO/BPS technical comments to the Preliminary Report and the data from the sample analyses.

3.0 AIR

The air-related portion of the Survey will involve an assessment of activities that emit or have a potential to emit one or more air-contaminating materials, the emission controls or administrative procedures applied to restrict those emissions, and any effluent or ambient air-quality monitoring equipment, procedures, and data. The Survey will address those air contaminants for which air-quality standards (criteria pollutants) or emission standards (new source performance standards or emission standards for hazardous air pollutants) have been established by the United States Environmental Protection Agency or by Louisiana Air Pollution Control Regulations. Also to be reviewed are tanks regulated under 40 CFR 60, subpart K, New Source Performance Standards.

The primary SPR contacts for the air specialist will be designated by PMO/BPS to suit the plan indicated in Table 2-2.

3.1 Issue Identification

As a result of a preliminary review of documents provided by the Strategic Petroleum Reserve Project Management Office and information provided during the pre-Survey site visit, hydrocarbons (volatile organic compounds) represent the air contaminant of greatest concern. Emissions of volatile organic compounds, total suspended particulates, sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, and hydrogen sulfide will be considered as part of the Survey.

The general approach of the Survey will include a review of existing air permits and any pending applications, as well as pertinent literature including standard operating procedures. Emission sources and emission-control equipment will be inspected, with emphasis on operations and activities capable of emitting, but not limited to, volatile organic compounds to the atmosphere. Of special interest will be the emissions from oil/brine separation ponds and from tanks. Fugitive emissions from valve stems and pump seals will be investigated. Resuspension of dust from unpaved roads will be evaluated as a potential source of airborne particulate contaminants. Air contaminant sources that do not have or do not require air permits and any emission-control strategies will also be reviewed.

In addition, the Survey will review any air-monitoring devices and procedures used to monitor atmospheric contaminants.

Several areas of specific interest have been identified as a result of a preliminary review of available documents:

o Sources of potential sources of volatile organic compound emissions to the atmosphere.

- Crude oil storage tanks.
- Slop oil tanks.
- Oil/Brine separation ponds.
- Valve stems and pump seals.

- Vapor Recovery Unit at Weeks Island.
- o Sources or potential sources of particulate dust emissions to the atmosphere.
 - Vehicular traffic on unpaved roads.
 - Stationary diesel engines.
 - Wind-blown dust.
- o Sources or potential sources of sulfur dioxide emissions.
 - Smokeless flare.
- o Detection system for hazardous gases at Weeks Island.

Throughout the Survey, emphasis will be placed on assessing available data and any future data generated by SPR within the timeframe of the overall Survey to characterize the overall environmental impact of SPR operations. Where data gaps exist, recommendations for additional sampling and analysis may be developed for follow-up by the Sampling and Analysis Team.

3.2 Records Required

Additional documents will be reviewed as part of the Survey, including documents not yet received (e.g., classified documents, individual files, and documents not yet identified). Specific documents and files requested for review while on-site include, but will not be limited to, the following:

Weeks Island

- o Descriptive information on construction and operation of the smokeless flare.
- o Air-quality impact analysis of sulfur dioxide emissions from the flare.
- o Descriptive information on construction and operation of air eliminator valves.
- o Copy of report comparing actual emission ratio with limitations, as required by Condition 5 of LACC Permit No. 1105.
- o Permit indicates potential for hydrocarbon emissions during subsequent refill operation but Emission Inventory Questionnaire does not discuss. Why not?

Bayou Choctaw

- o No additional information requested.

St. James Terminal

- o Plan for correcting tank seal deficiencies revealed in May 1987 inspection.

4.0 SURFACE WATER/DRINKING WATER

The surface water related portion of Phase II of the Strategic Petroleum Reserve (SPR) Environmental Survey will be concerned with the liquid discharges from stormwater and sanitary waste treatment facilities at each site. It will also be concerned with the discharges of brine to injection wells. The potable, fire, seal and flush water systems at the sites will also be addressed in this portion of the Survey.

4.1 Issue Identification

Based on the documentation supplied by the Strategic Petroleum Reserves Project Management Office as well as the site tour during the pre-Survey site visit, the surface water issues at the Phase II SPR sites include sewage treatment and stormwater discharges to adjacent surface waters. The issues also include the discharge of aqueous film forming foam (AFFF) used in firefighting, oil and brine spills into waters adjacent to the site, and the acquisition of suitable potable water at Weeks Island and Bayou Choctaw.

The Survey will include identification of potential discharges to surface waters, which may not be addressed in operating permits or other documents from SPR. The Survey will also assess the potential for contamination (inorganic and organic) of wastewaters. Measures taken to prevent back-flow of non-potable waters into the potable water piping systems will be reviewed. The potential for flooding of the sites also will be reviewed.

A walk-through of the facilities will be made to observe normal routines, including maintenance activities which generate wastewaters. A review will also be made of possible undetected sources of contaminants flowing to the sanitary sewage systems to confirm the findings in SPR Sewage Treatment Plant Analysis (SS86-0003-09). Discharge and monitoring points will be reviewed, and actual sampling procedures will be observed. The adequacy of the monitoring programs and systems will be assessed. The wastewater collection, holding and treatment systems will be examined and records of operations reviewed. The capacity of sewage treatment plants and oil/water (brine) separators will be reviewed. The objective of the review is to build a Survey information base for the identification of physical evidence of existing or potential environmental contamination.

The primary contacts for the survey water specialist will be the site environmental specialists and the site chemists. Interface with operations and/or maintenance personnel at each site will be necessary to discuss preventative maintenance programs for wastewater (brine) treatment facilities, cross connection identification and correction programs, and operations of the water treatment systems at each site.

4.2 Records Required

During the pre-Survey review of documents supplied by SPR, the following additional data and documents were identified as being of interest to the surface water specialist.

- o Discharge Monitoring Reports (DMRs) for each site.

- o Analytical Data collected from the stormwater, brine, and wastewater discharges at each site (i.e., data used to compile DMRs and the Annual Environmental Monitoring Reports).
- o Analytical Data from the rawwater, firewater and/or potable water systems at each site.
- o Site Operations Manual for Weeks Island (152-82-WI-001) Sections 4.1,4.8,5.1,5.2,5.3,7 and 10.4, Appendices G and H.
- o Site Operations Manual for Bayou Choctaw (152-82-BC-001) Sections 4,5.1,5.3,5.4,7,10.3, Appendices F and G.
- o Site Operations Manual for Saint James Terminal (152-82-SJ-001) Sections 4,5.1,5.3,5.4,5.6,10.4, Appendices A-139,A-140,A-141,A-142,A-148, and A-151.
- o Records of residuals (sludge and sediment) disposal from wastewater treatment systems.

5.0 GROUNDWATER

The Survey effort will focus on the existence of contamination, its migration potential, and the adequacy of environmental monitoring program. This effort will involve determination of the status of on-going studies, assessment of the adequacy of existing monitoring wells, and the review of plans for further investigations, regulatory compliance, and remedial action.

5.1 Issue Identification

Several areas of specific interest have been identified through the pre-Survey site visit briefings and review of the data received from the Project Management Office and Boeing Petroleum Services. These issues are discussed below.

Suspected In-Leakage of Water to Weeks Island Oil Storage Area

Brine is present in the sumps below the oil fill holes in the Weeks Island mine. This brine could be the result of water leakage through salt into the oil storage area. An uncontrolled pathway to the oil storage area could allow escape of oil to the environment.

The probable source of this water can be determined only by measurements of the rate of refill after pumping out enough brine to allow refill to occur. Only a small amount of brine has been removed because arrangements had to be made for disposal of larger amounts. Disposal in an oilfield injection well has now been arranged and pumping should have begun by the time of the on-site Survey. The history of this problem and the results of current studies will be reviewed on-site.

Lack of a Leak Detection System for the Bayou Choctaw Brine Pond

The brine pond at Bayou Choctaw could be an undetected source of groundwater contamination. This pond apparently does not have an underdrain system such as that at Big Hill or Sulphur Mines. The two monitoring wells near this pond have not been sampled since 1984, in part because of the absence of well logs and other background information necessary for proper interpretation of sampling data. It should be possible to measure the total depth of these wells even if the screened interval cannot be determined. The condition of the brine pond and the environmental threat of the lack of a monitoring system will be evaluated during the on-site Survey.

Potential Groundwater Problems at Weeks Island and Bayou Choctaw

An attempt will be made to understand the local groundwater regime at Weeks Island and Bayou Choctaw and its relationship to DOE and off-site operations. Matters of interest include discharge areas such as the springs on the northern slopes of Weeks Island and the perched groundwater in lakes and ponds at the same site. The potential for contamination of groundwater beneath DOE property from active and inactive off-site operations will be investigated within the time constraints of the Survey.

These matters and others identified prior to or during the on-site portion of the Survey will be discussed with appropriate contacts for the groundwater specialist. These contacts include Sidney Evans (DOE/PMO), Melissa Smith (DOE/PMO), Bill Bozzo (BPS), Joyce Teerling (BPS), and Doug Russell (BPS). It is possible that Mike Huff (BPS), Jimmy Salinas (BPS), Chris Upton (BPS), Brian Luckianow (PB-KBB) and other PB-KBB personnel will also be contacted.

5.2 Records Required

Information to be reviewed during the Phase II on-site Survey includes matters pertinent to SPR in general, follow-up items from the sites surveyed in Phase I, and records for the three Phase II sites.

Specific documents and information to be reviewed as part of the Survey include, but will not be limited to, the following:

- o Letters and memos concerning brine in fill hole sumps at Weeks Island.
- o Well locations and construction diagrams from new well installation at West Hackberry (or detailed plans if the work is not yet complete).
- o Update on status of sole source petition for the Chicot aquifer (pertinent to Weeks Island as well as the Phase I Survey sites).
- o SPR-wide inventory of unused test holes, core holes, and water supply wells, with the general plugging and abandonment plan for these holes (includes Bayou Choctaw).
- o Update on regulatory and technical aspects of plugging and abandonment of unused cavern wells, including specific problems at Bayou Choctaw.
- o Available data on groundwater use near the SPR sites and names of persons and agencies who may have additional information. (It is recognized that the SPR is not required under any regulations to compile these records. However, the Survey needs this information and any assistance would be appreciated.)

6.0 HAZARDOUS/SOLID WASTE

6.1 Issue Identification

The hazardous/solid waste element of the Environmental Survey will identify and record all wastes (hazardous and non-hazardous) generated; document waste storage, recycling and disposal practices; and identify any related problems that could result in the contamination of environmental media. The Survey procedure will involve the following activities:

- o Observe site operations and waste generation;
- o Observe waste management practices and inspect waste management facilities;
- o Interview site personnel regarding waste generation and waste management practices (observed and unobserved);
- o Review waste management files; and
- o Compare on-site observations with SPR procedures and records.

Wastes known to be generated include:

o Drilling muds	o Anhydrites
o Drill cuttings	o Brine

- o Dredge and excavation spoil
- o Construction and demolition debris
- o Spent solvents, thinners, and paints
- o Spill cleanup material
- o Sewage treatment plant sludge
- o Waste oils
- o Tank bottoms and brine pond sediments
- o Nonhazardous industrial waste
- o Nonhazardous municipal waste

Based on information provided and reviewed to date, hazardous wastes are infrequently generated on-site and are disposed of off-site at commercial facilities. EPA has classified the SPR sites as nonhandlers of hazardous wastes.

Waste management facilities to be inspected include:

- o A lined brine pond at Bayou Choctaw;
- o Three brine disposal wells at Bayou Choctaw;
- o A closed anhydrite disposal pit at Bayou Choctaw;
- o Pits for disposal of drilling muds and drill cuttings, which have been cement stabilized, at Bayou Choctaw;
- o Waste accumulation points and storage areas, including dumpsters.

In addition, above ground and underground waste tanks (e.g., sumps and waste oil tanks) will be surveyed.

Special attention will be paid to waste segregation, waste minimization, and waste accumulation. Other issues to be pursued include:

- o Contamination of Cavern #10 at Bayou Choctaw and plans for corrective action;
- o Integrity of the Bayou Choctaw brine pond, leak detection measures (e.g., an underdrain system and sump, groundwater monitoring, etc.); and the potential for groundwater contamination;
- o Flood protection measures; and
- o Off-site waste disposal.

Discussions will be held with individuals knowledgeable of current and past waste management practices. This will be accomplished during site tours and in the process of reviewing records and documentation. The objective is to develop an understanding of past and existing waste management activities that may serve as the basis for problem identification by the Survey team. The Waste Management Specialist on the Survey team will interview site personnel, including the site Environmental Specialist and operations personnel (e.g., supervisors of waste management and brine disposal). He will also contact the SPR Environmental Manager, Environmental Coordinator and Environmental Administrator on an as-needed basis. The review of hazardous/solid waste will be coordinated with the inactive waste sites, surface water and hydrogeologic elements of the Survey to identify any possible releases that may pose a threat to the environment.

6.2 Records Required

Records on waste generation and waste management activities will be reviewed while on-site to verify and update documented information. Records include:

- o Waste generator biennial reports;
- o Industrial nonhazardous waste quarterly reports;
- o Annual waste storage summaries;
- o Louisiana Department of Natural Resource Office of Conservation (LOC) manifests, and manifest quarterly reports;
- o Tank cleaning and tank bottom transportation authority forms;
- o Detailed spill cleanup disposal reports (i.e., where were wastes sent?)
- o Inspection files (e.g., weekly inspection forms, internal audits and EPA/state audits).

7.0 TOXIC/HAZARDOUS SUBSTANCES

The toxic/hazardous substances portion of the Environmental Survey will address raw materials and operations-related chemicals used at the SPR sites included in Phase II of the Environmental Survey, i.e., Weeks Island, Bayou Choctaw, and St. James Terminal. In addition, the handling, storage and disposal of specific chemicals regulated under the Toxic Substances Control Act (polychlorinated biphenyls (PCBs), chlorofluorocarbons, and asbestos) and the Federal Insecticide, Fungicide and Rodenticide Act (pesticides) will be evaluated. The condition and environmental monitoring of underground and above ground storage tanks used for bulk chemical substances other than wastes will also be examined. Through interviews with key SPR personnel and tours of relevant facilities, the tracking, control and management of toxic/hazardous substances will be reviewed. This information and records of usage will be used to identify possible environmental problems through a determination of whether or not the systems, equipment and programs established by SPR for the management of toxic/hazardous substances are adequate to minimize, to the extent feasible, potential environmental contamination.

7.1 Issue Identification

The documents that have been submitted to the Environmental Survey for review thus far indicate that all oil-filled SPR transformers currently contain fluid with less than 5 ppm PCB. At some SPR sites, transformers that previously contained fluids contaminated with PCBs have been drained and refilled with non-PCB oil. In addition, purchase specifications have been established that prohibit the purchase of new transformers that contain PCBs.

During the Environmental Survey at Weeks Island, Bayou Choctaw, and St. James Terminal the procedures that have been used to retrofit any transformers at these sites and dispose of the waste PCBs will be reviewed. Transformer sampling data that substantiate the claim that no previously-contaminated transformers now contain oils with a PCB concentration in excess of 5 ppm will be requested and evaluated. Any sampling or quality assurance data pertaining to the PCB content of newly-purchased transformers will also be reviewed. In particular, the files related to the disposal of a PCB transformer from the Weeks Island site in 1981 will be of interest. Finally, any additional information that may be in the possession of the SPR sites regarding the disposal of other materials contaminated with PCBs will be assessed.

All SPR sites use asbestos-filled gaskets in the pipeline systems, and an SPR-wide procedure for handling these gaskets has been developed. It is also known that at least one SPR site (i.e., Bryan Mound) has removed asbestos from site buildings and disposed of asbestos wastes. Files related to any similar projects performed at Weeks Island, Bayou Choctaw or St. James Terminal will be requested during the Environmental Survey. Any records related to the disposal of asbestos wastes from these sites will also be reviewed.

Pesticides are used at Weeks Island, Bayou Choctaw, and St. James Terminal. During the Environmental Survey, the areas where pesticides are mixed, stored or applied by SPR personnel will be inspected. Records of pesticide applications will be reviewed. At those sites where contractors are used to apply pesticides, the controls that have been implemented by SPR to prevent misuse or improper disposal of pesticides by the contractor will be evaluated.

The training program and associated records for SPR employees (and if available, contractor personnel) who work or have worked with pesticides will also be of interest to the team.

Toxic/hazardous chemicals are stored and used in both bulk and smaller quantities at SPR. Areas where toxic/hazardous materials are used and/or stored will be visited during the Survey. Notable in this regard are the laydown yards at Weeks Island and Bayou Choctaw. Procedures covering the purchase of toxic/hazardous materials will also be reviewed.

The procedures, equipment and programs that have been developed by SPR to comply with 40 CFR 112, "Oil Pollution Prevention" will be thoroughly assessed during the Environmental Survey. All files related to spill prevention and control, and spill events will be reviewed. Of particular interest will be the four 16.8 million gallon and two 8.4 million gallon above ground crude oil storage tanks at St. James Terminal.

The contact for the toxic/hazardous substances portion of the Survey is the Site Environmental Specialist.

7.2 Records Required

Files will be reviewed as part of the Survey, including documents not yet received (e.g., classified documents, individual files, documents not yet identified). Specific documents and files to be collected and reviewed during the Environmental Survey include:

- o Records covering the disposal of a PCB-contaminated transformer in 1981 from the Weeks Island site.
- o PCB sampling and analysis data for all oil-filled transformers at Bayou Choctaw, Weeks Island and St. James Terminal.
- o Procedures that are (or have been) used to retrofill transformers that contain fluids contaminated with PCBs and associated sampling data.
- o Documentation that any landfills used by Weeks Island, Bayou Choctaw or St. James Terminal to dispose of asbestos-containing wastes are permitted to receive such wastes.
- o Any site-specific procedures covering the purchase, handling, mixing, application and disposal of pesticides at SPR.
- o Copies of current contracts and/or specifications for contractors who apply pesticides at SPR.
- o Training records for any SPR personnel who handle pesticides.
- o Pesticide application records for 1986 and 1987.
- o Toxic substances labeling and tracking system files.
- o Procedures for purchasing, handling, storing, using and disposing of toxic substances at Weeks Island, Bayou Choctaw, and St. James Terminal.

- o Environmental monitoring reports and procedures for underground storage tanks that contain non-waste materials.
- o Any Unusual Occurrence Reports that have been generated by the SPR sites.
- o Internal or external audits of any of the above programs.
- o Other records as determined on-site.

8.0 RADIOLOGICAL

The radiological portion of the Survey will involve an assessment of the SPR-wide radioactive sources, controls, monitoring and the related impact on the environment. The Strategic Petroleum Reserves do not process any radioactive materials nor handle any radioactive materials other than sealed sources.

8.1 Issue Identification

Sealed sources of radioactive materials do not generally present a risk of release of radioactivity to the environment unless the sources are damaged or disposed of improperly. A total of 126 Texas Nuclear, SGH Series density gauges are located on pipelines within the Bayou Choctaw, West Hackberry, Sulphur Mines and Bryan Mound sites. Each gauge unit contains between 100 and 400 millicuries of cesium-137. In addition, there are Princeton Gamma Tech Model 100 sulfur analyzers in laboratories at Bayou Choctaw, Bryan Mound, West Hackberry and St. James Marine Terminal. Each analyzer contains approximately 55 millicuries of iron-55.

The sealed sources in both the sulfur analyzers and the density gauges require periodic leak testing to verify that the integrity of the sources is maintained. The Survey team will review source leak test records at each site and, inspect the mounting configuration of representative density gauges at the sites.

8.2 Records Required

Additional records that are requested to be available for on-site review include the following:

- o Leak test and other radiological survey data for sealed sources.
- o Records of possession, use, transfer, and/or disposal of radioactive sources.
- o Reports of radiation safety audits conducted by BPS Safety Department.

9.0 QUALITY ASSURANCE

The quality assurance (QA) Survey of the environmental program will be primarily an evaluation of the site sampling and analytical capabilities at SPR. The intent will be to verify and review the quality assurance procedures for obtaining environmental samples, performing the analytical work to identify the concentration of pollutants, and the handling and reporting of data. The quality assurance (QA) Survey activities will consist of an examination of the methods used to assure that the collection and analysis of environmental samples at the SPR sites will result in the generation of valid data.

9.1 Issue Identification

The SPRs conduct monitoring for chemical parameters at NPDES permitted outfalls, fugitive hydrocarbon air emissions, surface water quality and groundwater quality (at selected locations). SPR has established a quality assurance program to support their environmental sampling and analysis efforts. According to SPR documentation, the QA program is based on the U.S. EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories. During the on-site portion of the Survey, the Survey team will review the implementation of this program. The QA Specialist will tour the laboratory facility and review laboratory records and procedures. During the second phase period (February 1 through 11, 1988), the Survey will include the Bayou Choctaw laboratory. The Survey team understands that the laboratory facilities at St. James Marine Terminal do not handle environmental samples,

but are used for crude oil analyses alone. The QA associated with the latter is not within the scope of the Survey, so the St. James laboratory will not be reviewed. If this understanding is not correct, the St. James laboratory operations will be included in this phase of the Survey.

Of particular interest to the Survey team are records and procedures related to internal quality assurance analyses, such as method blanks, spikes, and duplicates. Techniques used to evaluate the data and correction actions taken to resolve past out-of-control conditions will be examined.

The SPR laboratories participate in the EPA's Discharge Monitoring Report Quality Assurance studies and a SPR program in which blind samples are supplied to the laboratories by the Environmental Control Department. The Survey will review records on the laboratories past performance in these programs.

Equally important is the quality assurance applied to sampling. During the Survey, the QA specialist will review sampling procedures, field notebooks and sample custody records. If possible, arrangements should be made for the Survey team to observe sampling of one or more NPDES discharge points at each site.

The Site Field Chemist should be available for the laboratory tour and during review of QA records.

9.2 Records Required

The following additional records or documents are requested to be available for review during the on-site portion of the Survey:

- o Procedure manuals and quality assurance manuals supporting the sampling and analysis aspects of SPR environmental monitoring.
- o Summaries of internal quality assurance records.
- o Summaries of individual SPR laboratory performance in external performance evaluation programs.
- o Summaries of individual laboratory performance in SPR internal interlaboratory studies.
- o Internal QA audit reports on environmental sampling and analysis.
- o Regulatory agency audit reports on environmental sampling and analysis.
- o Sample custody records.
- o Laboratory notebooks.
- o Instrument calibration and maintenance records.

10.0 INACTIVE WASTE SITES/RELEASES (CERCLA)

This aspect of the Survey will focus on identifying environmental problems related to past waste disposal practices, past spills and releases; and the potential for current and future releases from such historical sites/events.

10.1 Issue Identification

The Survey will identify and inventory any existing and potential environmental problems and threats to the environment resulting from the handling, storage, and disposal of waste substances. This will be accomplished through investigations and analysis of the following:

- o Inactive materials handling, storage, and disposal sites and releases prior to Department of Energy (DOE) acquisition of the property;
- o Inactive materials handling, storage, and disposal sites and releases while under DOE purview;
- o Current practices for handling, storing, and disposing hazardous materials; and
- o The potential for future uncontrolled spills or releases on SPR lands.

Areas of the SPR sites that were used prior to DOE acquisition, for the handling or managing of materials that present a threat or potential threat to the environment, will be inspected and assessed. Adjacent land uses that may affect DOE property will also be investigated. These sites include:

- o Bayou Choctaw where one abandoned cavern (cavern 10) is known to have inexplicably lost brine to the environment and to be contaminated with a caustic material and lead, and nine other abandoned caverns that have not been completely characterized for their potential to create environmental problems;
- o Bayou Choctaw where prior uses included mud disposal and lumber operations;
- o Weeks Island where sodium sulfate, hydrochloric acid, and activated clay were manufactured, and company-owned housing existed;
- o The Morton Salt hazardous substance treatment unit and two dumps adjacent to Weeks Island; and
- o Industrial activities surrounding St. James Terminal.

Areas of SPR sites that were used subsequent to DOE acquisition, for the handling or managing of materials that present a threat or potential threat to the environment, will be inspected and assessed. These sites include:

- o Bayou Choctaw where drilling muds from DOE activities and Allied Chemical were disposed on-site, and there is a closed anhydrite disposal pit;
- o Brine disposal wells at Bayou Choctaw; and
- o St. James Terminal where spills have occurred on-site and off-site spills have the potential to affect the site.

Current practices of hazardous materials management will be analyzed through site interviews, reviews of site protocols, and site tours. Management practices, in conjunction with reviews of environmental monitoring and incident reports and hazardous substances inventories will be used in assessing the potential for future uncontrolled sites.

In addition to these identified areas, inactive tanks, piping systems, containers, borrow pits, and storage and disposal areas that may have held potentially harmful materials will be inspected and their status assessed. Past activities, including dust control, brine and other materials disposal practices, and spill clean-ups, will also be examined. If drilling muds or hazardous materials have been disposed off-site, we will want to know the location of the disposal sites and review available information on the types and quantities of materials disposed.

The Survey team will want to review available information and documents used to generate the CERCLA Phase I Installation Report and Phase II Confirmation Report. Examples of this information and documentation includes: map locations of all capped or backfilled sites, all spill, release, and disposal sites, and abandoned wells; personnel interview files; HRS evaluations; and sampling data.

The team will also want to review the environmental records pertaining to management and disposal of hazardous substances. Project design and analytical data generated in support of site clean-ups (remediation) and closures will also be reviewed. In addition, the team will review available engineering drawings of product storage and waste management facilities.

The Survey team would, if possible, like to meet on-site with one or more representatives of former property owners/operators (e.g., Wilbert's & Sons Lumber, Allied Chemical, and Morton Salt) as appropriate to discuss the historical use of the various properties before DOE acquisition. Historical newspaper clippings and photographs, particularly aerial photographs, would be most helpful. The team would also like to interview SPR personnel familiar with early DOE activities at each of the sites.

Primary contacts for this portion of the Survey will include personnel from Operations and Maintenance, the Site Environmental Specialists, and the Site Safety Administrators.

10.2 Records Required

The following records, among others, will be reviewed at the site:

- o Standard Operating Procedures regarding management of hazardous substances, disposal areas, and storage areas.
- o Engineering drawings of waste management facilities.
- o Geological/hydrogeological studies of the site.
- o Hazardous substances inventories.
- o Historical files on past operations and processes, substances used, and methods of handling and disposal.

- o Records of facility expansion.
- o Records of regulatory notification pertaining to inactive waste sites and potential areas of contamination (e.g., CERCLA 103(c)).
- o Spill Reporting Procedures Manual.
- o Description of former waste management facilities, including inactive buried tanks and structures.
- o Maps showing the location of the inactive materials handling areas, disposal areas, and release or spill sites.
- o "Interview files," if relevant, for the CERCLA Phase I Report.
- o Documents pertaining to known or suspected off-site contamination associated with SPR (e.g., mud disposal).
- o Documents pertaining to past remedial actions and closures.
- o Environmental records pertaining to past facility responses to hazardous substance spills and releases.
- o Aerial photographs of SPR sites (historical).

MONDAY, FEB. 1	TUESDAY, FEB. 2	WEDNESDAY, FEB. 3	THURSDAY, FEB. 4	FRIDAY, FEB. 5
<u>Weeks Island</u> 8-10-Environmental, Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-5-Review Requested Additional Information on Smokeless Flare 5-Team Meeting	<u>Weeks Island</u> 8-Review Air-Quality Impact Analysis of SO2 from Flare 9-Q&A Site Environmental Specialist 12-1-Lunch 1-Review Requested Additional Information 3-Develop Findings 5-Team Meeting	<u>Weeks Island</u> 8-Observe Vapor Recovery Unit 10-Reality Check 12-1-Lunch 1-3-Resolve Questions 3-4-Exit Meeting 4-Leave for Gonzales, LA	<u>Bayou Choctaw</u> 8-9:30-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-5-Review Environmental Files 5-Team Meeting	<u>Bayou Choctaw</u> 8-Develop Findings 12-1-Lunch 1-Reality Check 3-Resolve Questions 4:30-Exit Meeting
MONDAY, FEB. 8	TUESDAY, FEB. 9	WEDNESDAY, FEB. 10	<div style="text-align: center; font-size: 2em; opacity: 0.5;">DRAFT</div>	
<u>St. James Terminal</u> 8-9:30-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Revisit Tanks to Observe Roof Seals. Review Plan for Tank Roof Seal Repair. 5-Team Meeting	<u>St. James Terminal</u> 9-Reality Check 10-Resolve Questions 11-Exit Meeting 12-Leave for New Orleans (lunch enroute) 1-5-Review Environmental Data & Files 5-Team Meeting	<u>New Orleans Office</u> 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport		

SURFACE WATER - R. TARBERT

MONDAY, FEB. 1	TUESDAY, FEB. 2	WEDNESDAY, FEB. 3	THURSDAY, FEB. 4	FRIDAY, FEB. 5
<u>Weeks Island</u> 8 AM-Environmental, Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Review Analytical Data & Operations Manual 5-Team Meeting	<u>Weeks Island</u> 8-NPDES Sampling 11-Q&A Site Environmental Specialist 12-1-Lunch 1-Operations/Maintenance-Preventative Maintenance & Cross Connections 5-Team Meeting	<u>Weeks Island</u> 10-Reality Check 12-1-Lunch 1-Resolve Questions 3-Exit Meeting 4-Leave for Gonzales, LA.	<u>Bayou Choctaw</u> 8 AM-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Review Analytical Data & Operations Manual 3-Q&A Site Environmental Specialist 5-Team Meeting	<u>Bayou Choctaw</u> 8-NPDES Sampling 10-Operations/Maintenance-Preventative Maintenance & Cross Connections 12-1-Lunch 1-Reality Check 3-Resolve Questions 4:30-Exit Meeting
MONDAY, FEB. 8	TUESDAY, FEB. 9	WEDNESDAY, FEB. 10	<div> </div>	
<u>St. James Terminal</u> 8-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Operations/Maintenance-Preventative Maintenance & Cross Connections 4-Q&A Site Environmental Specialist 5-Team Meeting	<u>St. James Terminal</u> 8-NPDES Sampling 9-Reality Check 10-Resolve Questions 11-Exit Meeting 12-Leave for New Orleans (lunch enroute) 1-5-Review Environmental Data & Files 5-Team Meeting	<u>New Orleans Office</u> 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport		

HYDROGEOLOGY - M. ROBISON

MONDAY, FEB. 1	TUESDAY, FEB. 2	WEDNESDAY, FEB. 3	THURSDAY, FEB. 4	FRIDAY, FEB. 5
<u>Weeks Island</u> 8 AM-Environmental, Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour, including Underground 3-Review Documentation on Brine in Sumps at Fill Holes Discuss w/S. Evans 5-Team Meeting	<u>Weeks Island</u> 8-Orientation to off-site areas-ponds, springs, Morton dumps-for understanding of groundwater regime 12-1-Lunch 1-File Review 5-Team Meeting	<u>Weeks Island</u> 10-Reality Check 12-1-Lunch 1-Resolve Questions 3-Exit Meeting 4-Leave for Gonzales, LA	<u>Bayou Choctaw</u> 8 AM-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-5-Check on Status of Abandoned Caverns-any sampling done? Review Environmental Files on Brine Disposal Wells 5-Team Meeting	<u>Bayou Choctaw</u> 10-Observe Demonstration of Monitoring Well Sampling 12-1-Lunch 1-Reality Check 3-Resolve Questions 4:30-Exit Meeting
MONDAY, FEB. 8	TUESDAY, FEB. 9	WEDNESDAY, FEB. 10		
<u>St. James Terminal</u> 8 AM-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Check on Groundwater implications of impoundment and of surrounding facilities 5-Team Meeting	<u>St. James Terminal</u> 9-Reality Check 10-Resolve Questions 11-Exit Meeting 12-Leave for New Orleans (lunch enroute) 1-5-Review Environmental Data & Files 5-Team Meeting	<u>New Orleans Office</u> 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport		

QA/RADIATION/TECHNICAL COORDINATION - D. YESSO

MONDAY, FEB. 1	TUESDAY, FEB. 2	WEDNESDAY, FEB. 3	THURSDAY, FEB. 4	FRIDAY, FEB. 5
<u>Weeks Island</u> 8 AM-Environmental, Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Technical Coordination 5-Team Meeting	<u>Weeks Island</u> 8-NPDES Sampling 11-Technical Coordination 12-1-Lunch 1-Technical Coordination 5-Team Meeting	<u>Weeks Island</u> 10-Reality Check 12-1-Lunch 1-Resolve Questions 3-Exit Meeting 4-Lunch for Gonzales, LA 5-Team Meeting	<u>Bayou Choctaw</u> 8 AM-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Tour Laboratory/Review QA Records & Procedures	<u>Bayou Choctaw</u> 8-NPDES Sampling 10-Technical Coordination 12-1-Lunch 1-Reality Check 3-Resolve Questions 4:30-Exit Meeting
MONDAY, FEB. 8	TUESDAY, FEB. 9	WEDNESDAY, FEB. 10		
<u>St. James Terminal</u> 8-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Technical Coordination 5-Team Meeting	<u>St. James Terminal</u> 8-NPDES Sampling 9-Reality Check 10-Resolve Questions 11-Exit Meeting 12-Lunch for New Orleans (lunch enroute) 1-5-Review Environmental Data & Files 5-Team Meeting	<u>New Orleans Office</u> 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Lunch for Airport		

WASTE MANAGEMENT - G. KELLY

MONDAY, FEB. 1	TUESDAY, FEB. 2	WEDNESDAY, FEB. 3	THURSDAY, FEB. 4	FRIDAY, FEB. 5
<u>Weeks Island</u> 8 AM-Environmental Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Start File Review 5-Team Meeting	<u>Weeks Island</u> 10-Q&A Site Environmental Specialist File Review 12-1-Lunch 1-File Review 5-Team Meeting	<u>Weeks Island</u> 10-Reality Check 12-1-Lunch 1-Resolve Questions 3-Exit Meeting 4-Leave for Gonzales, LA	<u>Bayou Choctaw</u> 8 AM-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-File Review Q&A Site Environmental Specialist 5-Team Meeting	<u>Bayou Choctaw</u> 10-File Review Q&A Site Environmental Specialist 12-1-Lunch 1-Reality Check 3-Resolve Questions 4:30-Exit Meeting
MONDAY, FEB. 8	TUESDAY, FEB. 9	WEDNESDAY, FEB. 10		
<u>St. James Terminal</u> 8-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-File Review Q&A Site Environmental Specialist 5-Team Meeting	<u>St. James Terminal</u> 9-Reality Check 10-Resolve Questions 11-Exit Meeting 12-Leave for New Orleans (lunch enroute) 1-5-Review Environmental Files 5-Team Meeting	<u>New Orleans Office</u> 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport		

TOXIC/HAZARDOUS SUBSTANCES - R. GERLACH

MONDAY, FEB. 1	TUESDAY, FEB. 2	WEDNESDAY, FEB. 3	THURSDAY, FEB. 4	FRIDAY, FEB. 5
<p><u>Weeks Island</u></p> <p>8 AM-Environmental, Safety/Security Briefings</p> <p>10-12-Tour</p> <p>12-1-Lunch</p> <p>1-3-Tour</p> <p>3-Review Files Related to PCB Issues at Weeks Island</p> <p>5-Team Meeting</p>	<p><u>Weeks Island</u></p> <p>8-Review SPCC Files</p> <p>10-Review Pesticide Files</p> <p>12-1-Lunch</p> <p>1-Meet with Weeks Island Environmental Specialist</p> <p>3-Review Files in Purchase, Use, & Storage of Toxic/Hazardous Substances</p> <p>5-Team Meeting</p>	<p><u>Weeks Island</u></p> <p>10-Reality Check</p> <p>12-1-Lunch</p> <p>1-Resolve Questions</p> <p>3-Exit Meeting</p> <p>4-Leave for Gonzales, LA</p>	<p><u>Bayou Choctaw</u></p> <p>8 AM-Environmental, Safety/Security Briefings</p> <p>9:30-12:30-Tour</p> <p>12:30-1:30-Lunch</p> <p>1:30-Review Files Related to PCB Issues at Bayou Choctaw</p> <p>3-Review SPCC Files</p> <p>5-Team Meeting</p>	<p><u>Bayou Choctaw</u></p> <p>8-Review Pesticide Files</p> <p>9:30-Review Files on Purchase, Use & Storage of Toxic/Hazardous Substances</p> <p>11-Meet with Bayou Choctaw Site Environmental Specialist</p> <p>12-1-Lunch</p> <p>1-Reality Check</p> <p>3-Resolve Questions</p> <p>4:30-Exit Meeting</p>
MONDAY, FEB. 8	TUESDAY, FEB. 9	WEDNESDAY, FEB. 10	<p><i>REMOVED</i></p>	
<p><u>St. James Terminal</u></p> <p>8-Environmental, Safety/Security Briefings</p> <p>9:30-12:30-Tour</p> <p>12:30-1:30-Lunch</p> <p>1:30-Review Files Related to PCB Issues</p> <p>2:30-Review SPCC Files</p> <p>3:30-Review Pesticide Files</p> <p>4:30-Review Files on Purchase, Use & Storage of Toxic/Hazardous Substances</p> <p>5-Team Meeting</p>	<p><u>St. James Terminal</u></p> <p>9-Reality Check</p> <p>10-Resolve Questions</p> <p>11-Exit Meeting</p> <p>12-Leave for New Orleans (lunch enroute)</p> <p>1-5-Review Environmental Data & Files</p> <p>5-Team Meeting</p>	<p><u>New Orleans Office</u></p> <p>8-Reality Check</p> <p>10-12-Resolve Questions</p> <p>12-1-Lunch</p> <p>1-3-Close-out</p> <p>3-Leave for Airport</p>		

TABLE 2.2

SUMMARY AGENDA

	AIR	WATER	HYDROGEOLOGY SOIL	CERCLA HAZ/SOLID WASTE	TESA	QA/QAD
MONDAY FEBRUARY 1	<p><u>Weeks Island</u> 8-10-Environmental, Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-5-Review Requested Additional Information on Smokeless Flare 5-Team Meeting</p>	<p><u>Weeks Island</u> 8-AM-Environmental, Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Review Analytical Data & Operations Manual 5-Team Meeting</p>	<p><u>Bayou Choctaw</u> 8-AM-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-5-Check on Status of Abandoned Caverns-any sampling done? Review Environmental Files on Brine Disposal Wells</p>	<p><u>Bayou Choctaw</u> 8-AM-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-File Review QMA Site Environmental Specialist 5-Team Meeting</p>	<p><u>Weeks Island</u> 8-AM-Environmental, Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Review Files Related to PCB Issues at Weeks Island 5-Team Meeting</p>	<p><u>Weeks Island</u> 6-AM-Environmental, Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Technical Coordination 5-Team Meeting</p>
TUESDAY FEBRUARY 2	<p><u>Weeks Island</u> 8-Review Air-Quality Impact Analysis of SO₂ from Flare 9-QMA Site Environmental Specialist 12-1-Lunch 1-Review Requested Additional Information 3-Develop Findings 5-Team Meeting</p>	<p><u>Weeks Island</u> 8-APDES Sampling 11-QMA Site Environmental Specialist 12-1-Lunch 1-Operations/Maintenance-Preventative Maintenance & Cross Connections 5-Team Meeting</p>	<p><u>Bayou Choctaw</u> 10-Observe Demonstration of Monitoring Well Sampling 12-1-Lunch 1-Reality Check 3-Resolve Questions 4:30-Exit Meeting</p>	<p><u>Bayou Choctaw</u> 10-File Review QMA Site Environmental Specialist 12-1-Lunch 1-Reality Check 3-Resolve Questions 4:30-Exit Meeting</p>	<p><u>Weeks Island</u> 8-Review SPCC Files 10-Review Pesticide Files 12-1-Lunch 1-Meet with Weeks Island Environmental Specialist 3-Review Files in Purchase, Use, & Storage of Toxic/Hazardous Substances</p>	<p><u>Weeks Island</u> 8-APDES Sampling 11-Technical Coordination 12-1-Lunch 1-Technical Coordination 5-Team Meeting</p>
WEDNESDAY FEBRUARY 3	<p><u>Weeks Island</u> 8-Observe Vapor Recovery Unit 10-Reality Check 12-1-Lunch 1-3-Resolve Questions 3-4-Exit Meeting 4-Leave for Gonzales, LA</p>	<p><u>Weeks Island</u> 10-Reality Check 12-1-Lunch 1-Resolve Questions 3-Exit Meeting 4-Leave for Gonzales, LA</p>	<p><u>St. James Terminal</u> 8-AM-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Check on Groundwater Implications of Impoundment and Surrounding Facilities 5-Team Meeting</p>	<p><u>St. James Terminal</u> 8-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-File Review QMA Site Environmental Specialist 5-Team Meeting</p>	<p><u>Weeks Island</u> 10-Reality Check 12-1-Lunch 1-Resolve Questions 3-Exit Meeting 4-Leave for Gonzales, LA</p>	<p><u>Weeks Island</u> 10-Reality Check 12-1-Lunch 1-Resolve Questions 3-Exit Meeting 4-Leave for Gonzales, LA</p>

TABLE 2.2

SUMMARY AGENDA

	HYDROGEOLOGY					QA/RAD
	AIR	WATER	SOIL	HAZ/SOLID WASTE	TS/CA	
THURSDAY FEBRUARY 4	<p><u>Bayou Choctaw</u> 8-9:30-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-5-Review Environmental Files 5-Team Meeting</p>	<p><u>Bayou Choctaw</u> 8 AM-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Review Analytical Data & Operations Manual 3-QA Site Environmental Specialist 5-Team Meeting</p>	<p><u>Weeks Island</u> 8 AM-Environmental, Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour, including Underground 3-Review Documentation on Brine in Sumps at Flit Holes Discuss w/S. Evans 5-Team Meeting</p>	<p><u>Weeks Island</u> 8 AM-Environmental, Safety/Security Briefings 10-12-Tour 12-1-Lunch 1-3-Tour 3-Start File Review 5-Team Meeting</p>	<p><u>Bayou Choctaw</u> 8 AM-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Review Files Related to PCB Issues at Bayou Choctaw 3-Review SPCC Files 5-Team Meeting</p>	<p><u>Bayou Choctaw</u> 8 AM-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Tour Laboratory/Review QA Records & Procedures</p>
FRIDAY FEBRUARY 5	<p><u>Bayou Choctaw</u> 8-Develop Findings 12-1-Lunch 1-Reality Check 3-Resolve Questions 4:30-Exit Meeting</p>	<p><u>Bayou Choctaw</u> 8-IPDES Sampling 10-Operations/Maintenance-Preventative Maintenance & Cross Connections 12-1-Lunch 1-Reality Check 3-Resolve Questions 4:30-Exit Meeting</p>	<p><u>Weeks Island</u> 8-Orientations to off-site areas-ponds, springs, Norton dumps-for understanding of ground water regime 12-1-Lunch 1-File Review 5-Team Meeting</p>	<p><u>Weeks Island</u> 10-QA Site Environmental Specialist File Review 12-1-Lunch 1-File Review 5-Team Meeting</p>	<p><u>Bayou Choctaw</u> 8-Review Pesticide Files 9:30-Review Files on Purchase, Use & Storage of Toxic/Hazardous Substances 11-Meet with Bayou Choctaw Site Environmental Specialist 12-1-Lunch 1-Reality Check 3-Resolve Questions 4:30-Exit Meeting</p>	<p><u>Bayou Choctaw</u> 8-IPDES Sampling 10-Technical Coordination 12-1-Lunch 1-Reality Check 3-Resolve Questions 4:30-Exit Meeting</p>
MONDAY FEBRUARY 8	<p><u>St. James Terminal</u> 8-9:30-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Revise Tanks to Observe Roof Seals. Review Plan for Tank Roof Seal Repair. 5-Team Meeting</p>	<p><u>St. James Terminal</u> 8-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Operations/Maintenance-Preventative Maintenance & Cross Connections 4-QA Site Environmental Specialist</p>	<p><u>Weeks Island</u> 10-Reality Check 12-1-Lunch 1-Resolve Questions 3-Exit Meeting 4-Leave for Gonzales, LA</p>	<p><u>Weeks Island</u> 10-Reality Check 12-1-Lunch 1-Resolve Questions 3-Exit Meeting 4-Leave for Gonzales, LA</p>	<p><u>St. James Terminal</u> 8-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Review Files Related to PCB Issues 2:30-Review SPCC Files 3:30-Review Pesticide Files 4:30-Review Files on Purchase, Use & Storage of Toxic/Hazardous Substances</p>	<p><u>St. James Terminal</u> 8-Environmental, Safety/Security Briefings 9:30-12:30-Tour 12:30-1:30-Lunch 1:30-Technical Coordination 5-Team Meeting</p>

TABLE 2.2

SUMMARY AGENDA

	AIR	WATER	HYDROGEOLOGY SOIL	CERCLA HAZ/SOLID WASTE	TSCA	QA/RAD
TUESDAY FEBRUARY 9	St. James Terminal 9-Reality Check 10-Resolve Questions 11-Exit Meeting 12-Leave for New Orleans (lunch enroute) 2-5-Review Environmental Data & Files 5-Team Meeting	St. James Terminal 8-NPDES Sampling 9-Reality Check 10-Resolve Questions 11-Exit Meeting 12-Leave for New Orleans (lunch enroute) 2-5-Review Environmental Data & Files 5-Team Meeting	St. James Terminal 9-Reality Check 10-Resolve Questions 11-Exit Meeting 12-Leave for New Orleans (lunch enroute) 2-5-Review Environmental Data & Files 5-Team Meeting	St. James Terminal 9-Reality Check 10-Resolve Questions 11-Exit Meeting 12-Leave for New Orleans (lunch enroute) 2-5-Review Environmental Data & Files 5-Team Meeting	St. James Terminal 9-Reality Check 10-Resolve Questions 11-Exit Meeting 12-Leave for New Orleans (lunch enroute) 2-5-Review Environmental Data & Files 5-Team Meeting	St. James Terminal 8-NPDES Sampling 9-Reality Check 10-Resolve Questions 11-Exit Meeting 12-Leave for New Orleans (lunch enroute) 2-5-Review Environmental Data & Files 5-Team Meeting
WEDNESDAY FEBRUARY 10	New Orleans Office 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport	New Orleans Office 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport	New Orleans Office 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport	New Orleans Office 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport	New Orleans Office 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport	New Orleans Office 8-Reality Check 10-12-Resolve Questions 12-1-Lunch 1-3-Close-out 3-Leave for Airport

APPENDIX C

SITE-SPECIFIC SURVEY ACTIVITIES

C.1 Pre-Survey Preparation

The DOE Office of Environmental Audit and Compliance, Assistant Secretary for Environment, Safety, and Health selected a team to conduct an Environmental Survey of the Strategic Petroleum Reserve (SPR), which is located in Texas and Louisiana. The SPR is operated for DOE by Boeing Petroleum Services (BPS), Inc. Mr. Thomas Traceski was designated DOE Team Leader and Ms. Donna Bergman, the Assistant Team Leader. Other team members included technical specialists from NUS Corporation and ICF Technology. Battelle, Columbus Division was designated to provide a sampling team for the SPR Survey and to perform the laboratory analytical services. The sampling and analysis (S&A) functions were subsequently reassigned to Idaho National Engineering Laboratory.

A pre-Survey site visit was conducted October 13-15, 1987, by the Team Leaders, the NUS technical coordinator and hydrogeologist, and a representative from the Battelle sampling and analysis team. Following introductions, SPR Project Management Office (PMO) personnel presented an overview of activities at the facility and discussed environmental issues of concern to them. The logistics of the upcoming Survey were discussed and a facility tour at Bayou Choctaw was provided. In addition, meetings were held on October 14 and 15, 1987, with officials of the states of Louisiana and Texas, respectively, to inform them of Survey activities and to hear their concerns with regard to SPR. The Environmental Protection Agency (EPA) Region VI also attended the meeting on October 15, 1987.

Subsequently, NUS and ICF technical specialists intensively reviewed the environmental documents and reports that were provided by SPR-PMO. Based on that review, a Survey plan for the SPR was prepared, which discussed the specific approach to the Survey for each of the technical disciplines and included a proposed schedule of on-site activities. Because the SPR consisted of seven sites along the Texas-Louisiana Gulf Coast, the Survey was conducted in two phases. The Survey plan for Phase I was transmitted to the SPR-PMO and BPS on November 13, 1987. The Phase II plan was transmitted during the week of January 18, 1988.

C.2 On-Site Activities

The on-site portion of Phase I of the Survey was conducted at four of the SPR sites during the period of November 30 through December 11, 1987. The opening meeting, held on November 30, 1987, was attended by representatives from DOE Headquarters, the SPR-PMO, BPS, NUS Corporation, and ICF Technology. Discussions during this meeting centered on the purpose of the Survey, logistics at the SPR sites, and an introduction of the personnel involved. Phase II on-site activities took place during the period of February 1-10, 1988.

During the on-site portion of the Survey, team members reviewed additional file materials including permits and applications, background studies, engineering drawings, unusual occurrence reports, and operating logbooks. The site activities were thoroughly analyzed to identify existing and potential pollutants. Site operations and monitoring procedures were observed. Extensive interviews were conducted with site personnel regarding environmental controls, operations, monitoring and analysis, past operations, regulatory permits, and waste management.

Meetings of the Survey team members were held to report observations and compare findings. The team also coordinated daily with PMO and BPS personnel to arrange for specific site personnel and facilities to be available, as needed, on the following day. The sampling and analysis requirements identified by the Survey team members were discussed as they developed.

Closeout briefings were held on December 11, 1987 and on February 10, 1988. At these briefings, the DOE Team Leader presented the preliminary observations of the Survey team. These observations were classified as preliminary, because additional research and, in some cases, additional field sampling were required to positively confirm the observations.

C.3 Sampling and Analysis

Idaho National Engineering Laboratory (INEL) is preparing a Sampling and Analysis Plan that will include the sampling requests made by the Survey team, a quality assurance plan, and a health and safety plan. This plan will be submitted to the SPR-PMO upon completion. Sampling is scheduled for Fiscal Year 1989.

C.4 Report Preparation

A draft preliminary Survey report for the SPR was prepared to summarize the findings from the on-site Survey effort. This report will be provided to the Oak Ridge Operations Office, the SPR-PMO, and the SPR contractor for review. The findings presented in the draft report are considered preliminary, until comments are received and S&A results are available. At that time, the comments and S&A results will be evaluated and an Interim Report will be prepared.

APPENDIX D

CHEMICAL SYMBOLS, ABBREVIATIONS, AND ACRONYMS

CHEMICAL SYMBOLS, ABBREVIATIONS, AND ACRONYMS

AFFF	-	Aqueous Film Forming Foam
API	-	American Petroleum Institute
AQCR	-	Air Quality Control Region
bbl	-	Barrel
BFI	-	Browning Ferris Industries
BOD	-	Biochemical Oxygen Demand
BOD ₅	-	5-Day Biochemical Oxygen Demand
BPS	-	Boeing Petroleum Services, Inc.
BS&W	-	Basic Sediment and Water
CAA	-	Clean Air Act
CaSO ₄	-	Calcium Sulfate
CERCLA	-	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	-	Chlorofluorocarbon
CFR	-	Code of Federal Regulations
Ci	-	Curie
CO	-	Carbon Monoxide
COA	-	Certificate of Approval
COD	-	Chemical Oxygen Demand
CY	-	Calendar Year
DEQ	-	Louisiana Department of Environmental Quality
DMR	-	Discharge Monitoring Report
DNR	-	Louisiana Department of Natural Resources
DO	-	Dissolved Oxygen
DOE	-	U.S. Department of Energy
ECD	-	BPS Environmental Control Department
EIQ	-	Emission Inventory Questionnaire
EP	-	Extraction Procedure
EPA	-	U.S. Environmental Protection Agency
EPPM	-	Environmental Program and Procedures Manual
ERT	-	Emergency Response Team
°F	-	Degree Fahrenheit
FR	-	Federal Register
FSC	-	Freeport Sulphur Company
ft	-	Foot (Feet)

FY	-	Fiscal Year
gpd	-	Gallons per Day
gpm	-	Gallons per Minute
g/kg	-	Gram per Kilogram
HCl	-	Hydrochloric Acid
HDPE	-	High Density Polyethylene
HF	-	Hydrofluoric Acid
HPP	-	High-Pressure Pump
ICW	-	Intracoastal Waterway
kg/mo	-	Kilogram per Month
LACC	-	Louisiana Air Control Commission
lb/hr	-	Pound per Hour
LDC	-	Louisiana Department of Conservation
LDEQ	-	Louisiana Department of Environmental Quality
LECC	-	Louisiana Environmental Control Commission
LHWR	-	Louisiana Hazardous Waste Rules
LOC	-	Louisiana Department of Natural Resources Office of Conservation
LR	-	Louisiana Register
MCC	-	Material Control Center
mCi	-	MilliCurie
mg/L	-	Milligram per Liter
MB/D	-	Thousand Barrels per Day
ml	-	Milliliters
MMB	-	Million Barrels
MOU	-	Memorandum of Understanding
MSA	-	Metropolitan Statistical Area
MSDS	-	Material Safety Data Sheet
MSL	-	Mean Sea Level
NAAQS	-	National Ambient Air Quality Standards
NaCl	-	Sodium Chloride (Halite)
NESHAP	-	National Emission Standards for Hazardous Air Pollutants
NH ₄ Cl	-	Ammonium Chloride
NO _x	-	Nitrogen Oxides
NPDES	-	National Pollutant Discharge Elimination System
O&G	-	Oil and Grease
OEG	-	Office of Environmental Guidance
ORO	-	Oak Ridge Operations Office

OSHA	-	Occupational Safety and Health Act
PAH	-	Polynuclear Aromatic Hydrocarbons
Pb	-	Lead
PB-KBB	-	Parsons, Brinkerhoff-Kavernen Bau-Betriebs
PCB	-	Polychlorinated Biphenyl
PM-10	-	Particulate Matter Equal To or Smaller Than 10 Micrometers
PMO	-	Project Management Office
POSSI	-	Petroleum Operations and Support Services, Inc.
ppb	-	Parts per Billion
ppm	-	Parts per Million
ppt	-	Parts per Thousand
psia	-	Pounds per Square Inch Absolute
PVC	-	Poly Vinyl Chloride
QA	-	Quality Assurance
RCRA	-	Resource Conservation and Recovery Act
RCT	-	Railroad Commission of Texas
RWIS	-	Raw-Water-Intake Structure
SARA	-	Superfund Amendments and Reauthorization Act
S&A	-	Sampling and Analysis
SCS	-	Soils Conservation Service
SDV	-	Standard Deviation Variation
SO ₂	-	Sulfur Dioxide
SPCC	-	Spill Prevention, Control, and Countermeasures
SPR	-	Strategic Petroleum Reserve
SPRO	-	Strategic Petroleum Reserve Operations (Office)
SRDC	-	Sabine River Diversion Canal
STP	-	Sewage Treatment Plant
SWD	-	Salt Water Disposal
T-7 Error	-	Trend-seven Error
TACB	-	Texas Air Control Board
TDH	-	Texas Department of Health
TDS	-	Total Dissolved Solids
TOC	-	Total Organic Carbon
tpy	-	Tons per Year
TSP	-	Total Suspended Particulates
TSS	-	Total Suspended Solids
TWC	-	Texas Water Commission

UIC	-	Underground Injection Control
USBC	-	U.S. Bureau of Census
USGS	-	U. S. Geological Survey
UST	-	Underground Storage Tank
VOC	-	Volatile Organic Compounds
WHA	-	Walk, Haydel & Associates, Inc.
$\mu\text{g}/\text{m}^3$	-	Microgram Per Cubic Meter
$\mu\text{mhos}/\text{cm}$	-	Micromhos Per Centimeter

PRELIMINARY

END

DATE FILMED

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