STRATEGIC PETROLEUM RESERVE

ANNUAL ENVIRONMENTAL MONITORING REPORT

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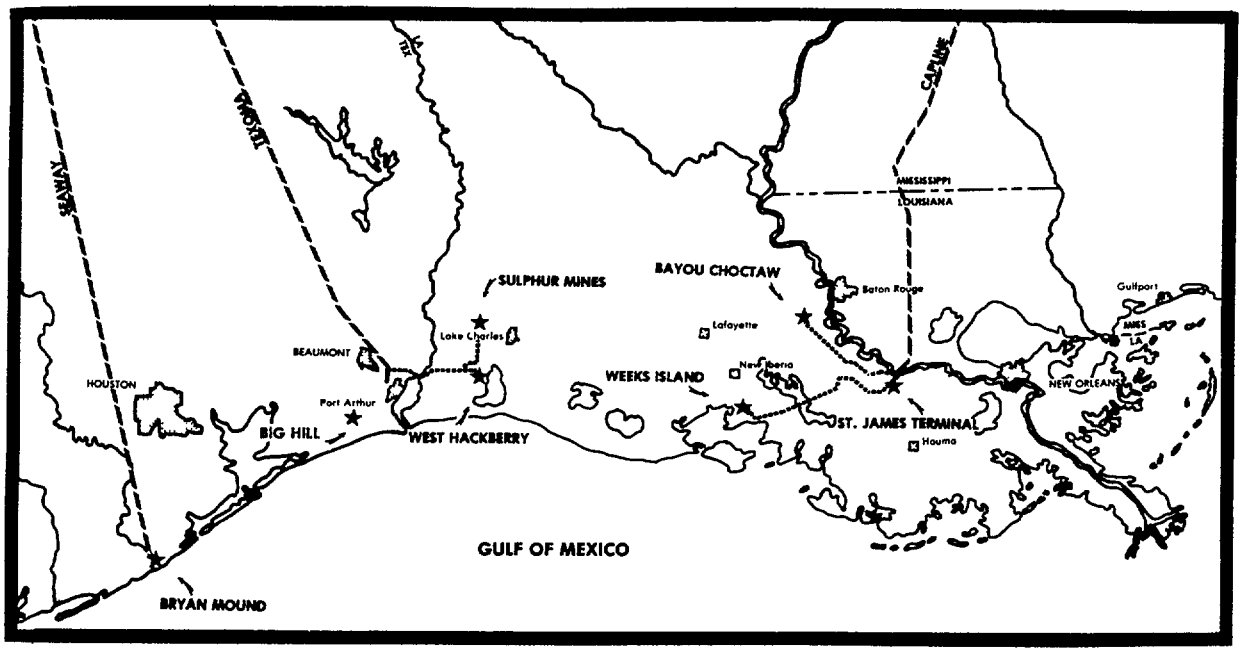

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Petroleum Operations and Support Services, Inc.
850 South Clearview Parkway
New Orleans, Louisiana 70123

ANNUAL
ENVIRONMENTAL MONITORING
REPORT
FOR THE
STRATEGIC PETROLEUM RESERVE

For The Period

January 1984 through December 1984

124-84-AS-001

PETROLEUM OPERATIONS AND SUPPORT SERVICES, INC.

850 South Clearview Parkway

New Orleans, Louisiana 70123

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DISCLAIMER

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1. INTRODUCTION

The creation of the Strategic Petroleum Reserve (SPR) was mandated by Congress in Title 1 Part B of the Energy Policy and Conservation Act (P.L. 94-163) and passed on December 22, 1975. Its purpose is to provide the United States with sufficient petroleum reserves to minimize the effects of an oil supply interruption.

The SPR consists of six Gulf Coast underground salt dome oil storage complexes (four in Louisiana and two in Texas) and a marine terminal facility (in Louisiana). The SPR made use of existing storage capacity early in the project by utilizing four sites with existing solution mined caverns and a conventional underground salt mine. Additional space has been and is being created by solution mining at four sites. The sixth and newest site is in the drilling/construction phase.

The sites were constructed around three major inland pipeline systems capable of transporting U.S. and foreign crude oil from the Gulf Coast to refineries in the Midwest. The inland pipeline terminals planned for use by the SPR are the Seaway Terminal (Freeport, Texas), the Texoma Pipeline Terminal (Nederland, Texas), and the Capline Pipeline Terminal (St. James, Louisiana). The sites are also capable of distributing crude oil via tankships.

1.1 BAYOU CHOCTAW

The Bayou Choctaw site is located on the west side of the Mississippi River 12 miles southwest of Baton Rouge in Iberville Parish, Louisiana. The area surrounding the site is rural, with a number of people living in small settlements along the nearby highways. Baton Rouge is the major source of housing and services for the site and is within easy commuting distance (DOE FEIS Capline Group, Vol. I, section 3.5.2.8). The site itself consists of four existing solution mined caverns. A fifth cavern, in which solution mining was completed during 1984, will be used as a transfer cavern in 1985. A sixth cavern is in the drilling phase.

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The habitat surrounding the site is a freshwater swamp. 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 creating 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 1955 resulted in the formation of a 12-acre lake (Cavern Lake) on the north side of the site.

The site is located near the intersection of several major bayous and waterways. The Intracoastal Waterway (Port Allen Canal) passes in a north-south direction west of the site. The Intracoastal Waterway extends to the north and then turns eastward through the Port Allen Canal to enter the Mississippi River at Baton Rouge. In the area of the site, the Intracoastal Waterway is part of Choctaw Bayou, a natural waterway.

Bayou Grosse Tete enters from the northwest and intersects the Intracoastal Waterway south of the site with an interconnecting crossover almost due west of the site. Bayou Bourbeaux enters the area from the northeast and passes through Cavern Lake to form the North-South Canal through the site. The East-West Canal extends in a generally east-west direction on the southern side of the site intersecting Bayou Bourbeaux and continuing to Bull Bay and the Intracoastal Waterway. The Wilbert Canal flows east-west in an area north of the brine disposal wells and joins the Intracoastal Waterway near its intersection with Bayou Grosse Tete.

Bottomland hardwood forest and deciduous swamps are predominant at the Bayou Choctaw site. The overstory vegetation at the site includes baldcypress and tupelogum (characteristic of lowland areas), bulltongue, and spikerushes. Water oak is also present but not abundant.

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The deciduous swamp is the most widespread habitat type found at the site. It provides resources for a large number of wildlife. Bird species common at Bayou Choctaw are herons, egrets, woodpeckers, wood duck, thrushes, and American woodcock. Inhabitants of the bottomland forest and swamp include opossum, squirrels, nutria, mink, river otter, raccoon, swamp rabbit, white-tailed deer, alligator, and snakes.

1.2 BIG HILL

The Big Hill facility is located in Jefferson County, Texas approximately 68 miles east of Houston, 23 miles southwest of Port Arthur and nine miles north of the Gulf of Mexico. Only small unincorporated communities are located in proximity to the site. The rural nature of the area around the site is best expressed by the economy which is dominated by rice farming, cattle grazing, and oil and gas production. The permanent workforce is expected to be supplied in small part from the local area with the remainder moving into the area or commuting from Beaumont-Port Arthur. During the current construction phase, much of the transient skilled labor may be brought in from Houston, Galveston, or Lake Charles (DOE SEFIS Phase III Expansion, section 3.2.1.8).

The site is situated on about 275 acres of land atop the Big Hill salt dome. The dome itself is covered with 1,200- to 1,300-foot thick caprock with surface elevations of up to 35 feet above sea level (the highest elevations in the region). The agricultural and pasture land uses around Big Hill are typical of the region.

No wetlands occur within the immediate vicinity of the site. However, less than a mile south of the dome is the northern boundary of fresh to intermediate marsh which grades into brackish and saline marsh towards the Gulf of Mexico. The nearby waterways include Spindletop Ditch approximately three

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miles south of the site, which connects to the Intracoastal Waterway two miles further south running in a northeast to southwest direction. General freshwater impoundments are located south of the site. Numerous sloughs, bayous, and lakes including Willow Slough Marsh, Salt Bayou, Star Lake, and Clam Lake connect with the Intracoastal Waterway. There is a remnant chenier paralleling the coastline which at the present time isolates the marsh from the Gulf of Mexico.

Existing habitats in the vicinity of the complex are related to agricultural use although there are petroleum-related, industrial operations on and off the salt dome. There are two ponds present on the eastern edge of the dome, one of which is on SPR property, and a row of century old live oak trees.

The upland habitat which comprises the majority of the site consists of many tall grasses such as bluestem, indiangrass, switchgrass, and prairie wildgrass. Fauna typical in the area include rabbits, raccoon, rodents, snakes, turtles, and numerous upland game birds and passerines. The adjacent grasslands which have been cultivated for rice crops are popular feeding grounds for wintering waterfowl. The nearby ponds and marsh south of the site provide excellent alligator habitat.

1.3 BRYAN MOUND

The Bryan Mound site is located in Brazoria County, about 65 miles due south of Houston, Texas and three miles southwest of Freeport, Texas on the east bank of the Brazos River Diversion Channel near its junction with the Gulf of Mexico. The area is highly industrialized, with petroleum related facilities representing a significant share of the market. Approximately 50 percent of the area population are between 20 and 55 years of age and work in the local area, although many commute in to work from outside the immediate vicinity. (DOE FEIS Seaway Group, Vol. I, section 3.3.8).

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The site is in the southwest apex of a triangle formed by the Brazos River Diversion Channel, the old Brazos River, and the Intracoastal Waterway. A U.S. Army Corps of Engineers silt gate controls the flow of water between the Intracoastal Waterway and the Diversion Channel. The Bryan Mound site is situated atop a salt dome, which creates a surface expression in the terrain by rising about 15 feet above the surrounding wetlands. The levees protecting the town of Freeport to the northeast form a second triangular pattern within the triangle formed by the rivers. A levee parallels the Brazos River to the west of the site. A second levee north of and parallel to the Intracoastal Waterway essentially bisects the site, intersecting the Brazos River levee and proceeding northeast.

The major nearby water bodies are Blue Lake, north of the site, and Mud Lake to the south. These water bodies generally define the mounded aspect of the dome upon which Bryan Mound is located. Blue Lake is within the 3.4-square-mile protective triangle formed by the levee system. Although Blue Lake is essentially isolated by the levees (with excess rain water being drained off by two large pump stations operated by the city of Freeport), there is some drainage through culverts southward into the Intracoastal Waterway. Mud Lake, on the other hand, is directly connected with the Intracoastal Waterway.

The marsh and prairie areas surrounding Bryan Mound, typical of those found throughout this region of the Texas Gulf Coast, have no unique natural or scenic features. In all low-lying areas, brackish marshland dominates the site with the exception of the northern area of the site where the coastal prairie ecosystem extends along the levees paralleling the Brazos River Diversion Channel. The coastal prairie is covered with medium to very tall grasses which form a moderate to dense cover for wildlife. These grasses are usually found in the site area where soil moisture extends to a great depth. Those areas periodically inundated by seawater are dominated by marsh hay cordgrass.

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A diverse range of habitats is created by the water bodies surrounding Bryan Mound. Marshes and tidal pools, such as Mud Lake and Bryan Lake, which connect with the Gulf of Mexico by way of the Intracoastal Waterway or the Brazos River, are ideal habitats for a variety of birds, aquatic life, and mammals. On the site and in surrounding areas of Bryan Mound, the common egret, snowy egret, migratory waterfowl, great blue heron, least tern and black-necked stilt (the latter two are state protected species), killdeer, nutria, raccoon, skunk, rattlesnakes, turtles, and frogs can be found.

In Mud Lake, larval shrimp and fish, adult crabs, trout, flounder, and redfish can be found during various seasons of the year. Black drum, mullet, gar, and blue crab are found in Blue Lake.

1.4 ST. JAMES TERMINAL

The St. James Terminal is located on the west bank of the Mississippi River approximately halfway between New Orleans and Baton Rouge, Louisiana. It lies approximately 1.9 miles north of the town of St. James on Louisiana Highway 18. As at Bayou Choctaw, the area around the site is rural with a number of people living in small settlements along Highway 18, the major thoroughfare in the area. Although some of the work force may commute from Baton Rouge, the majority of the workers are from local labor pools (DOE FEIS Capline Group, Vol. I, section 4.3.2.8).

The terminal consists of six aboveground storage tanks, two tanker docks on the Mississippi River, and associated piping and pumping equipment. Tankships transfer oil to the terminal from the two docks (docks 1 and 2) located on the west bank of the river. A fire water dock is located next to upstream dock 1. The docks are connected to the terminal by way of pipelines which pass over Louisiana Highway 18 and then underground to the

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terminal. The site is bordered on the north by the Capline terminal and on the south by the LOOP Offshore Capline (LOCAP) terminal, which connects to the Louisiana Offshore Oil Port (LOOP) salt cavern storage facility in southern Louisiana.

The terminal itself is essentially enclosed by facilities or structures which block all land flow away from the site (the Texas and Pacific Railroad to the west, the above-mentioned terminal facilities to the north and south, and the Mississippi River levee on the east between Highway 18 and the river). The area adjacent to the Mississippi River at the St. James docks is considered a freshwater wetland (batture land). Much of the land area surrounding the terminal is used for pasture and sugar cane cultivation. This land is covered by a mixture of introduced cool and warm season grasses and legumes. Frogs, snakes, turtles, rabbit, raccoon, armadillo, muskrat, opossum, nutria, squirrels, egrets, ibis, and herons can be found on the site and in the surrounding areas.

1.5 SULPHUR MINES

The Sulphur Mines site is located in Calcasieu Parish, 1.5 miles west of the town of Sulphur, Louisiana. There has been constant activity on and around the salt dome since the late 1800's. The greater part of the work force comes from the town of Sulphur with the remainder from outlying communities and the major urban area of Lake Charles (DOE FEIS Sulphur Mines, section 2.5).

The site is divided into two areas, the quadrangular primary site and the figure-eight shaped secondary area. The primary site area is bordered on the east by several large bodies of water. The secondary site area is bordered on the west and northwest by water bodies. Most of these bodies of water are interconnected and drained by one creek flowing eastward from the site to Bayou D'Inde. A floodwater canal is located 1/4

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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. However, high waters in the spring season 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 and deciduous forest.

Mammals on site and in the surrounding areas are white-tailed deer, raccoon, fox squirrel, cottontail rabbit, opossum, striped skunk, armadillo, nutria, southern flying squirrel, white-footed mouse, and bobcat. Snakes, turtles, alligator, frogs, and toads can also be found. Crappie, large mouth bass, sunfish, gar, carp, bowfin, and catfish inhabit the shallow ponds on the Sulphur Mines site.

1.6 WEEKS ISLAND

The Weeks Island salt dome is located in Iberia Parish, Louisiana, about 14 miles south of New Iberia. Weeks Island is in a virtually uninhabited area. Away from the site the area is sparsely populated with an intermittent linear pattern of rural settlement. New Iberia, the closest major urban center, supplies the greater part of the labor force. The major employment sectors within the parish are mineral production, manufacturing, construction, and agriculture (DOE FEIS Capline Group, Vol. I, section 3.4.2.8).

The Weeks Island salt dome borders Vermilion Bay, which opens to the Gulf of Mexico. The Weeks Island salt mine, developed in the early 1900's by mechanical mining technology, continued to operate in part up until 1981. The SPR crude oil storage portion of this mine consists of two large underground excavations vertically oriented to each other and interconnected by bore holes resulting in two levels of "rooms and pillars" with total storage capacity of 74.5 million barrels.

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The surface expression over the salt dome which forms the island includes the highest elevation (171 feet) in southern Louisiana. The area surrounding the island is a combination of swamp, marsh, bayous, manmade canals, and bays contiguous with the Gulf of Mexico. The SPR site is located on the southwest slope of the island above a portion of the mine previously mentioned.

The vegetation on Weeks Island is quite varied. The island is characterized by lowland hardwood species which exist here because of the higher elevation afforded by the island and the presence of very fertile loam as a soil base. The dominant trees are oak, magnolia, and hickory, which extend down to the surrounding marsh. Pecan trees are also present. The coastal wetlands found at the Weeks Island site include the manmade Intracoastal Waterway and saline and brackish marshes and bayous. Gulls, terns, herons, and egrets are commonly found in and around the marshes. Mink, nutria, river otter, raccoon, and alligator are the most common inhabitants of the intermediate marshes. Others found in the environs of Weeks Island are opossum, bats, squirrels, swamp rabbit, bobcat, white-tailed deer, black bear, and coyote. The water bodies surrounding Weeks Island provide a vast estuarine nursery ground for an array of commercially and recreationally important finfish and shellfish.

1.7 WEST HACKBERRY

The West Hackberry site is located in Cameron Parish 18 miles southwest of Lake Charles, Louisiana and 16 miles north of the Gulf of Mexico. Cameron Parish, the largest and least populous parish in Louisiana, has no incorporated communities. The population derives its economy from fishing/shrimping, rice farming, and petroleum production. The work force at the site is derived in part from local residents of the Hackberry community, from recent arrivals to the area, and from the surrounding towns of

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Sulphur and Lake Charles in Caleasieu Parish (DOE FEIS Texoma Group, Vol. I, section 3.3.1.8, Phase III Expansion, section 3.2.4.8).

The site is situated on 290 acres of land on top of the West Hackberry salt dome. The dome itself is covered by a distinct mounded overburden on its western portion with elevations up to 21 feet (the highest point in Cameron Parish). The rest of the dome, an area of 890 acres, is elevated about five feet above sea level.

Waterways bordering the site include Calcasieu Lake and the Calcasieu Ship Channel approximately three miles to the east and the Intracoastal Waterway approximately four miles north of the site. Water bodies in the area of the site are connected to the Intracoastal Waterway by the north-south running Alkali Ditch. Black Lake, a brackish water lake, borders the "island" formed by the upwelling of the dome on the northern and western sides. Numerous canals and natural waterways, including Black Lake Bayou, connect Black Lake to the Alkali Ditch on the eastern side of the site. Black Lake Bayou wanders in a generally easterly direction from Black Lake, eventually connecting with the Calcasieu Ship Channel northeast of the town of Hackberry. A nearby canal that runs northeast to southwest connects Alkali Ditch directly with the eastern side of the site.

The western part of Cameron Parish consists of marshland with natural ridges extending in a generally east-west direction. These ridges, or cheniers, are stranded former beach lines, and they play a role in directing water flow through the marshes. The cheniers typically support grasses and trees. In many areas, lakes, bayous, and canals are concentrated so that the marsh may not seem to be a land mass at all but rather a large region of small islands. Marshland closest to the coast generally has the highest salinity levels and lowest species diversity. Vegetation

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found on site and in the surrounding area of the West Hackberry facility is dominated by Chinese tallow, bay, crape myrtle, live oak, and various species of marsh grass and upland crop grasses. Red fox, alligator, snakes, egrets, herons, roseate spoonbill, raccoon, nutria, opossum, rabbit, white-tailed deer, migratory waterfowl, and red-tailed hawk can be found on and in the area surrounding the West Hackberry facility. Aquatic inhabitants of Black Lake include crabs, drum, croaker, spot, sheepshead, shrimp, mullet, gar, redfish, oysters, and catfish.

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2. PROGRAM OVERVIEW

The Operations and Maintenance (O&M) contractor's Environmental Plan is designed to support the SPR's mission through the implementation of programs aimed at avoiding or minimizing adverse environmental effects on the SPR as well as surrounding lands and water bodies.

The monitoring and inspection program was developed using the Department of Energy (DOE) SPR Programmatic Environmental Action Report, Site Environmental Action Reports, and DOE Orders. The program includes monitoring permitted National Pollutant Discharge Elimination System (NPDES) outfalls, monitoring air emissions, and making other required federal and state inspections as well as regular sampling and analysis of site-associated surface water quality. This makes possible the assessment of environmental impacts and early detection of surface water quality degradation that may occur as a result of SPR operations.

The results of air quality monitoring and reporting, NPDES compliance, and water quality monitoring for calendar year 1984 are discussed in section 3.

2.1 ASSOCIATED PROGRAMS

Associated programs developed to support the SPR Environmental Plan include Spill Reporting Procedures, site-specific Oil Spill Contingency Plans, site-specific Spill Prevention Control and Countermeasures Plans, an Underground Injection Control Program, a Solid Waste Management Plan, and a Fugitive Emissions Monitoring Plan. Compliance with federal, state, and local laws, regulations, and permits has been accomplished by implementation of these programs.

2.2 TRAINING

Site Environmental and Emergency Response Team personnel have received training in support of the Environmental Plan and associated programs. Site management personnel were briefed on the implementation of the Environmental Plan, Spill Reporting

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Procedures, the site-specific Oil Spill Contingency Plans, the site-specific Spill Prevention Control and Countermeasures Plans, and compliance awareness. Compliance awareness training was conducted by the individual site environmental specialists at each of the SPR sites. During this training, site personnel learned about the SPR environmental program's applicable regulatory requirements.

Selected Emergency Response Team personnel from all sites have attended the Texas A&M University Oil Spill School. Personnel from all sites have participated in onsite training in oil spill cleanup and control. Consequently, site personnel are trained to respond rapidly and effectively in the containment and cleanup of oil spills under special circumstances unique to each SPR site.

2.3 REPORTING

Proper operation of the SPR with respect to the environment involves several types types of reports and reporting procedures. The basic types of reports are summarized briefly in this section.

2.3.1 Spill Reports

The O&M contractor developed and published a Spill Reporting Procedures manual (O&M contractor's publication number 124-82-AS-001) for use in reporting oil and brine spills to the Department of Energy. The size of spill, material spilled, and the state in which it is spilled are variables in the SPR reporting procedures. Generally any spill over five barrels is first verbally reported to site management and then the New Orleans O&M contractor management and the DOE representative followed by the individual state office, e.g. Water Pollution Control Division in Louisiana. Written reports follow after the appropriate cleanup has been accomplished. Complete details can be found in the manual.

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2.3.2 Discharge Monitoring Reports

Point source discharges on SPR sites are regulated by the Environmental Protection Agency (EPA) through its National Pollutant Discharge Elimination System program on either a monthly or quarterly basis. The required discharge sample analyses are reported to the state and EPA. At this time a report of any noncompliances or bypasses is attached as matter of record.

2.3.3 Other Reports

The O&M contractor provides other reports to DOE as required. These include, but are not limited to the following:

a. Air Emissions for Bryan Mound (quarterly):

b. Emissions Inventory Questionnaire for Saint James Terminal, Sulphur Mines, Weeks Island, and West Hackberry (annual);

c. Environmental permit listing and update (annual);

d. Spill Trend Analysis Report (annual); and

e. Annual Environmental Monitoring Report.

2.4 OIL SPILL RECAPITULATION

In calendar year 1984, the total amount of oil received was in excess of 71.4 million barrels. In that period of time, a total of 13 oil spills of 1 barrel or more occurred. Those spills totalled 848 barrels or .0012 percent of the oil received. This was a 65-percent reduction in the total volume of oil spilled as compared to 1983, or a 57-percent reduction in the ratio of oil spilled to oil received during 1984 as compared to 1983 and a 74-percent reduction in this ratio as compared to 1982. None of these 1984 spills reached a navigable waterway. All oil spills were contained within the system containment devices and recovered. Therefore, no reports were called into the National Response Center.

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2.5 BRINE SPILLS RECAPITULATION

The SPR disposed of 557.7 million barrels of brine (saturated sodium chloride solution) during calendar year 1984. Over 97 percent of this brine volume was disposed of in the Gulf of Mexico via the Bryan Mound and West Hackberry brinelines, while the remainder was disposed in saline aquifers via disposal wells at the Bayou Choctaw and Sulphur Mines sites. Despite the large volume of brine handled, only 17 spills of one or more barrels occurred for a total of 1,975 barrels, or 0.00035 percent of the total volume of brine disposed. During 1984, 30 fewer brine spills occurred than during 1983 representing a 64-percent reduction in the total number of brine spills. This sharp reduction is attributed to an elevated level of environmental awareness on the part of site personnel brought about by the training efforts of the site environmental staff.

2.6 NPDES COMPLIANCE

In calendar year 1984, approximately 2,134 NPDES-permitted and otherwise monitored discharges were made at the SPR facilities. Of these, 666 were associated with brine disposal to the Gulf of Mexico. Although there were 17 occurrences of permit noncompliance reported, the SPR was in compliance with the NDPES permit requirements for more than 99 percent of the discharges conducted during this reporting period.

2.7 OTHER PROGRAMS

During 1984 the Bryan Mound facility conducted soil sampling and analysis in response to a U.S. EPA Region VI Superfund Office investigation. Prior to the SPR's acquisition of Bryan Mound, Dow Chemcial, Hooker Chemical, Freeport Sulphur, and the City of Freeport, Texas engaged in activities such as solution mining for brine, Frasch sulfur mining, and operation of a municipal landfill at this site. These past activities and land uses led EPA to initiate an inspection of Bryan Mound for evidence of abandoned

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hazardous waste disposal sites. The EPA report identified four locations in which further investigation was recommended.

The SPR contracted with a third party to take soil core samples from five specified points at Bryan Mound (one sample from three of the locations and two from the fourth) and perform analysis for the 129 priority pollutants. The results of these analysis produced detectable levels of 36 different pollutants among the five samples ranging from less than 2.5 parts per billion to approximately 100 parts per million. Asbestos, the compound of particular interest to EPA at Bryan Mound, was not detected in any of the samples analyzed. EPA's Uncontrolled Hazardous Waste Site Ranking System (the Mitre Model) was utilized to facilitate a quantitative evaluation of the resultant data and its implications to the Bryan Mound environment. Scores (100 point scale) for migration (S_m) and direct contact (S_{dc}) for the four sample areas are:

S_m	1.98	3.83	1.75	2.97
S_{dc}	8.33	8.33	0.56	8.33

These scores suggest relatively low risk of migration of, or direct contact with, these pollutants. The fire and explosion score (S_{fe}) was not applicable to the Bryan Mound site.

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3. ENVIRONMENTAL PROGRAM

3.1 INTRODUCTION

A primary goal of the Operations and Maintenance (O&M) contractor is to ensure that SPR construction, operation, and maintenance activities are conducted in accordance with sound environmental practices. An effectual environmental monitoring program provides a mechanism for assessing the impact of SPR activity on the air, surface water, and ground water. The site monitoring programs were developed as management tools for the purpose of allowing control and mitigation of unwarranted environmental impacts, thus serving the public interest by ensuring environmentally sound operation of the SPR.

During 1984 air emissions were monitored through measurements and theoretical calculations. Volatile hydrocarbons arising from valves, pumps, tanks, tankers, and brine ponds are the predominant type of air emission from SPR facilities. The quantity of hydrocarbon emissions is generally dependent on the volume of oil throughput, with minimal emissions occurring during periods of static storage. Sulfur dioxide emissions occur during cavern fill at Weeks Island as a result of combustion of displaced gases. Dust emissions from site roads have been mitigated through either application of pavement or dust control agents.

During 1984 the surface waters of the Bayou Choctaw, Bryan Mound, Sulphur Mines, and West Hackberry SPR sites were sampled and monitored for general water quality by the respective site environmental and laboratory personnel. Surface water quality monitoring was not conducted at St. James Terminal or Weeks Island because of the lack of potentially impacted surface waters on or near these two sites. Surface water quality monitoring at Big Hill will be initiated at the onset of site operations there.

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The unique ecological characteristics and diverse history of the SPR sites preclude a standard water quality monitoring program. To facilitate effective evaluation of the site water quality data, the following SPR site water quality criteria were established and used:

pH	6.5 - 8.5 standard units
Salinity *	Significant variation from ambient
Temperature	32°C maximum
Total Suspended Solids**	10 mg/l or 30 mg/l
Total Dissolved Solids	500 mg/l
Dissolved Oxygen	5 mg/l
Biochemical Oxygen Demand**	10 mg/l or 30 mg/l
Total Organic Carbon	40 mg/l

* Surface waters throughout the SPR may be classified on the basis of salinity as polyhaline (30 to 18 ppt), mesohaline (18 to 5 ppt), oligohaline (5 to 0.5 ppt), or limnetic (less than 0.5 ppt) in accordance with the Venice system.

** 10 mg/l for the Bayou Choctaw site is based on Louisiana average discharge limitations into the classified stressed environment.

These criteria are based on federal, Louisiana, and Texas water quality criteria, environmental literature, and the professional judgment of the O&M contractor's Environmental Control Department. The criteria are intended solely as a yardstick against which changes in water quality may be measured rather than as a regulated criteria which the SPR is obligated to meet. Several additional parameters, such as macronutrients and major ions, are discussed in the text based on relative concentrations rather than absolute criteria.

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These water quality discussions proceed by water quality parameter describing trends and anomalies and discuss causal relationships where applicable including operation of site outfalls.

3.1.1 Water Discharge Permit Monitoring

The water discharge permit monitoring program consists of the control of National Pollutant Discharge Elimination System (NPDES) point source discharges in compliance with federal and state regulations which are enforced by the Environmental Protection Agency (EPA) and respective state agencies.

During 1984 all sites except Big Hill had discharged effluents to federal and/or state water bodies. These discharges can be grouped as follows:

a. brine discharge to the Gulf of Mexico,
b stormwater runoff, or
c. effluent from package sewage treatment plants.

Parameters monitored varied by site and by discharge. Table 3-1 identifies frequency of specific parameters measured at each of the operating sites. The individual variations are discussed by site following the water quality monitoring discussions.

3.1.2 Environmental Permits

The environmental permits required by regulatory agencies to construct and operate the SPR are listed by corresponding sites. Those that are listed represent active permits or permits in need of amendment or renewal in the near future. The discussion of site permits includes the number and type of noncompliances (if any) experienced by the site.

3.1.3 Hydrology and Ground Water Monitoring

Ground water monitoring is performed at three of the SPR sites. Bayou Choctaw, West Hackberry, and Bryan Mound each has at least

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PHYSICO-CHEMICAL PARAMETERS	SAMPLE IDENTIFICATION AND FREQUENCY BY SITE													
	DAILY					WEEKLY			MONTHLY					Q
	BC	BH	SJ	SM	WH	BH	SM	WH	BC	BH	SM	WI	WH	SJ
pH	003-012 E-J	001 101-116, 1,2, 4,5 TX-001	001	001 002 003 005 006	001 6-9, 11 101-117 HPP		004		001 002 A-D	A-J	A-G	001A 001B 002	002 A-E	002 003
SALINITY		001			001 HPP				A-F	A-J	A-G		A-E	
SPECIFIC CONDUCTIVITY									A-F	A-J	A-G		A-E	
TEMPERATURE		001			001				A-F	A-J	A-G		A-E	
TOTAL DISSOLVED SOLIDS					001	001					A-G		A-E	
TOTAL SUSPENDED SOLIDS					001	001	004		001 002 A-F		A-G	002 001B	002 A-E	002 003
CHLORIDE	010 011													
DISSOLVED OXYGEN					001				A-F	A-J			A-E	
BOD_5							004		A-F 001 002			002 001B	002	002 003
COD		002 TX-001 1,2, 4,5, 101-116								A-J				
OIL & GREASE	003-012 G-J	001 002 101-116 1,2, 4,5, TX-001	001		001 6-9, 11 101-117 HPP				A-F		A-G	001A	A-E	
TOC			001			001			A-F	A-J				
FECAL COLIFORM							004					002 001B	002	
FLOW	001-012	TX-001 001 002 1,2, 4,5, 101-116	001		HPP 001 6-9, 11, 101-117		004		001 002			001A-001B 002	002	002 003

NOTE: Water Quality Stations (lettered stations) are sampled for possible detection of any adverse environmental condition on and in the waters surrounding the SPR sites.

Table 3-1. Physicochemical Parameters

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three monitoring wells that are sampled a minimum of once per month. Various indicators are analyzed dependent upon the individual site although sampling and monitoring of these wells are not required by any federal or state regulations or permits.

There was no background information found on the construction or the installation of the existing monitoring wells or the geology and soil characteristics encountered during installation. The unique ground water characteristics of each individual site and monitoring analysis are discussed within each site section.

3.1.4 Radioactivity

The SPR does not handle radioactive materials in its operations, as do other DOE facilities. As such, DOE employees and workers with DOE contractors are not exposed to radiation and no calculations on radiation doses, potential or otherwise, are deemed appropriate. Therefore there are no site discussions on radioactivity in this report.

3.2 BAYOU CHOCTAW

3.2.1 Air Quality

During 1984 Bayou Choctaw operated in accordance with all air quality permit and regulatory requirements. No new air quality data was collected or developed during the last year. There were no configurational changes which would have resulted in additional air emissions during 1984. Bayou Choctaw is located in a nonattainment area for ozone.

3.2.2 Surface Water Quality Monitoring

Water quality monitoring of the Bayou Choctaw surface waters was generally conducted at monthly intervals throughout 1984. Specific monitoring stations are identified in Figure 3-1 by station A in Bayou Bourbeaux just north of Cavern Lake; station B in a culvert off the weak brine area leading to the East-West

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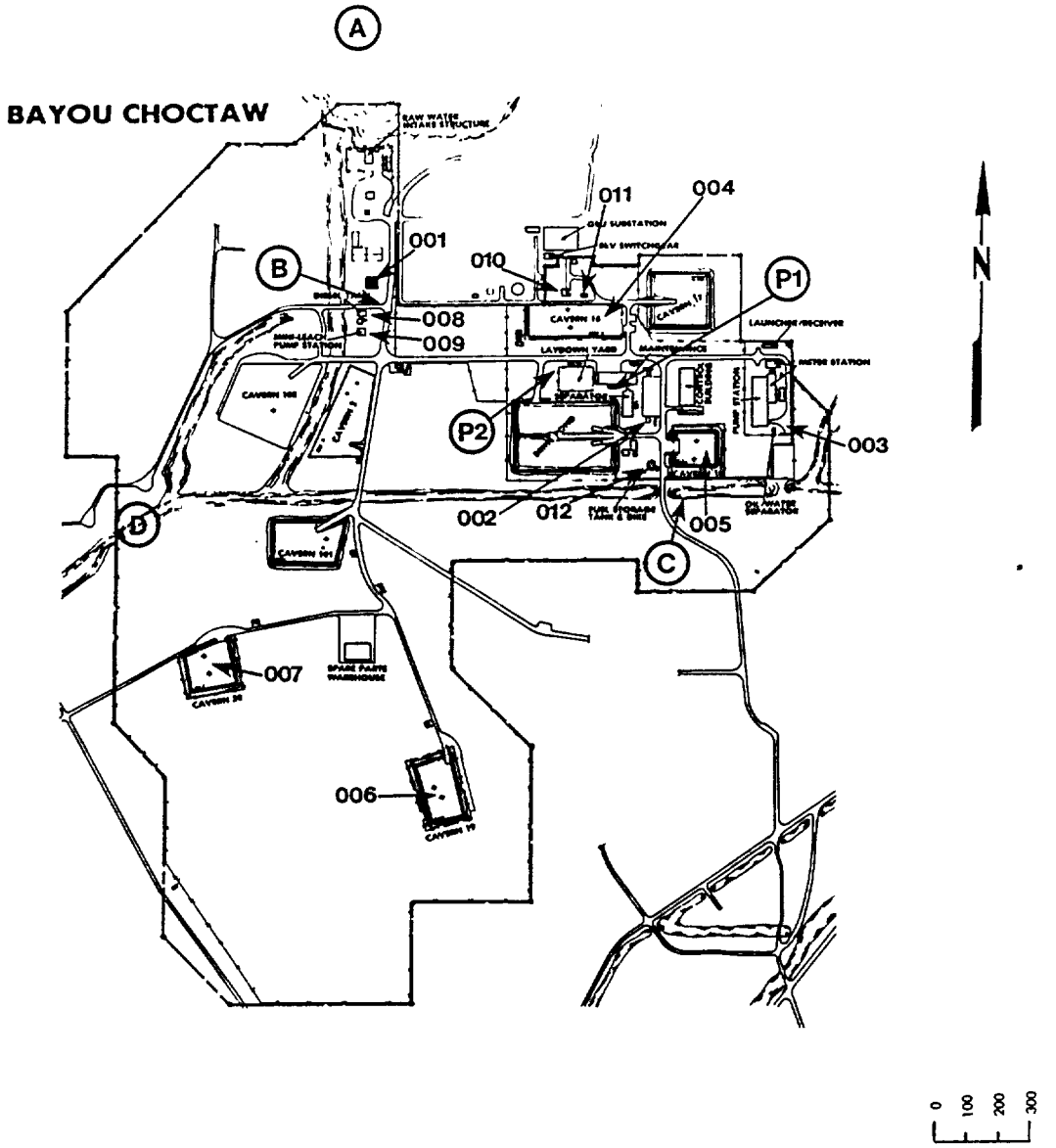

Figure 3-1 (Sheet 1 of 2). Bayou Choctaw Environmental Monitoring Stations

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Discharge Monitoring Stations

001	Discharge from the Sewage Treatment Plant at the Trailer Complex
002	Discharge from the Sewage Treatment Plant at the Administration Building
003	Discharge Point from the Oil/Water Separator at the High-Pressure Pump Pad/Meter Prover
004	Stormwater from Well Pad 15
005	Stormwater from Well Pad 18
006	Stormwater from Well Pad 19
007	Stormwater 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	North-South Canal at Bridge to Cavern Pads 10, 11, and 13
C	East-West Canal at Intersection of Road to Brine Disposal Wells
D	East-West Canal at North-South Road

Ground Water Monitoring Stations

P1	Southwest Corner Maintenance Building
P2	North of Brine Pond

Figure 3-1 (Sheet 2 of 2). Bayou Choctaw Environmental Monitoring Stations

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Canal; station C in the East-West Canal at the brine disposal well road; and station D in the East-West Canal at cavern 10. Parameters monitored in the Bayou Choctaw surface waters during 1984 include pH, salinity, total suspended solids (TSS), temperature, dissolved oxygen (DO), biochemical oxygen demand (BOD), and oil and grease. These parameters are discussed in turn and compared with 1982 and 1983 monitoring data. The discussions are followed by summary observations.

3.2.2.1 Hydrogen Ion Activity (pH)

The hydrogen ion activity, or pH, was slightly basic (pH greater than 7.0) in most cases. Measured pH's ranged from 6.6 to 8.4 with the pH falling below 7.0 in only 7 percent of the data. This moderately basic pH is characteristic of slightly hard natural waters with inorganic carbon predominantly in the carbonate ion form. The degree of toxicity or solubility of many compounds, such as hydrogen sulfide and aluminum, is enhanced by a low pH; thus, a slightly basic pH is beneficial to the aquatic ecology in terms of reducing the toxicity of indigenous or contaminating compounds. Additionally, moderately hard natural waters generally have increased buffering capacity to protect against pH fluctuations.

During 1982 and 1983 the pH was observed to fluctuate from 7.1 to 8.8 and 7.0 to 8.2. Thus, the 1982, 1983, and 1984 data suggest a slightly declining trend in the median pH which could be attributed to a variety of environmental factors such as fluctuations in rainfall or aquatic system flushing.

3.2.2.2 Salinity

The salinity at station A was zero throughout 1984. Station B was nonzero in June (1.0 ppt) and September (1.0 ppt), and station D was nonzero in February (1.0 ppt) and September (2.0 ppt). Station C ranged from zero during October to December to

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4.0 ppt during July. Station C, located on the East-West Canal to the south of the brine pond, has historically shown a slightly elevated level of salinity partially attributed to its proximity to the brine pond, wastewater treatment outfall, flood control system discharge, and brining activities conducted by prior tenants of Bayou Choctaw. The low to zero salinity observed at Station C from 1982 through 1984 does not appear to have impacted or altered this portion of the minimally flushed East-West Canal.

3.2.2.3 Total Suspended Solids

The 1984 TSS data were compared to a criterion of 10 mg/l established for the stressed surface waters at Bayou Choctaw. This represents a level of solids desired in order to relieve these surface waters of their indigenous stress. Observations at the four sample stations throughout 1984 exceeded the 10 mg/l criteria for 96 percent of the data.

This is relatively consistent with 94 percent and 88 percent of the respective 1983 and 1982 data, exceeding the 10 mg/l criterion. These data do not represent the result of SPR impact, but rather the degree of stress in the Bayou Choctaw surface waters as indicated by consistently high levels of TSS at all sample stations over a three year period.

Average annual TSS levels at stations A, B, C, and D were 31.8 mg/l, 26.9 mg/l, 40.0 mg/l, and 42.2 mg/l respectively. The highest TSS level (92.0 mg/l) was observed during June at station C which monitors water quality in the vicinity of outfall 002. However, no noncompliances from this outfall occurred during 1984, suggesting that the water quality at station C had not been adversely impacted by site discharges which, in fact, had lower levels of suspended solids than the receiving waters.

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3.2.2.4 Temperature

Temperatures ranged from 10°C at station D during January to 30°C at station D during July. Temperatures above 20°C were consistently observed at all stations except during the months of January, February, March, and November. The 1984 temperature range fell between the slightly cooler 1983 range of 9.5°C to 27°C and the slightly warmer 1982 range of 11°C to 31.5°C. The SPR produces no thermal discharges to surface waters; thus temperature fluctuations are attributed to seasonal variation and meteorological conditions.

3.2.2.5 Dissolved Oxygen

The DO ranged from 2.4 mg/l at station A during May and October to 11.2 mg/l at station B during January. DO was observed below the minimum criteria of 5.0 mg/l for 23 percent of the observations. Over half of the below minimum DOs occurred at station A with the remainder of these low observations distributed between stations C and D. All DO observations at station B were acceptable. The control station A is located some distance from SPR impacts; thus, its low DOs are not attributed to SPR activity. As there were no noncompliances during 1984, discharges do not appear to have impacted the surface water DOs. No significant correlations between depressed DO and temperature or BOD were observed. Thus, the fluctuation in DO is attributed to flushing of the surface water, meteorology (wind and rain induced), and primary production (as an oxygen source).

3.2.2.6 Biochemical Oxygen Demand

The observed five-day BOD ranged from <1.0 mg/l to 5.9 mg/l, well within the criterion maximum of 10 mg/l and consistent with the <1.0 mg/l to 6.5 mg/l range observed during 1983 and a similar range observed in 1982. These data are indicative of low organic loading in the Bayou Choctaw surface waters supporting the contention that the observed depressed DOs, discussed above, are not because of organic decomposition.

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3.2.2.7 Oil and Grease

Oil and grease were nondetectable during all observations throughout 1984. This is consistent with past observations during 1982 and 1983. These data demonstrate the effectiveness and efficiency of the operation and maintenance of the site's oil water separators. Additionally, these data reflect the site spill prevention efforts and the effectiveness of spill control and response efforts.

3.2.2.8 General Observations

Based on the above discussion, the following general observations are made regarding the quality of Bayou Choctaw surface waters.

a. Bayou Choctaw's surface waters continue to be moderately basic indicating the ecosystem is healthy.

b. The observed salinities were low for all stations. The intermittent slightly elevated salinities observed at station C are not of a significant impact to the Bayou Choctaw surface waters.

c. The consistently high TSS levels observed reflect ambient surface water conditions at Bayou Choctaw. Such conditions limit the depth of the photic zone and tend to smother invertebrates, thus damaging the base of the food chain. These conditions are not attributed to SPR operations, but rather appear indigenous to the area as demonstrated by consistently high TSS observations over three years at both site and control stations.

d. Low levels of DO were observed a significant number of times; however, this is a phenomenon characteristic of warm stagnant surface waters.

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e. The consistently low BOD and nondetectable oil and grease levels during 1982, 1983, and 1984 suggest that site oil spills and wastewater treatment plants are effectively managed, minimizing the impact on the Bayou Choctaw environs.

3.2.3 Water Discharge Permit Monitoring

The major permit monitoring is related to water discharges regulated under the Environmental Protection Agency's permit and a corresponding permit issued by the Louisiana Department of Natural Resources (LDNR) Office of Environmental Affairs. There are two categories of discharges, discharge from package sewage treatment plants and stormwater runoff from well pads and pump pads.

Parameters monitored from the two sewage treatment plants (outfalls 001 and 002) and from stormwater runoff of the well pads and pump pads are listed below along with their maximum limits.

Location/Discharge	Parameter	Maximum Value
sewage treatment plants	flow	(report)
	BOD_5	15 mg/l
	TSS	45 mg/l
	pH	$\geq$ 6.0 - $\leq$ 9.0 units
stormwater discharges	flow	(report)
	oil and grease	15 mg/l
	pH	$\geq$ 6.0 - $\leq$ 9.0 units

Of the 165 discharges made in 1984, all were in compliance, resulting in a 100 percent compliance level.

3.2.4 Active Permits

Table 3-2 lists the active permits at Bayou Choctaw. There were no noncompliances associated with these permits during 1984. As

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PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0053040	EPA	Water	8/9/81	3/12/83	(1)
WP0179	LDNR	Water	7/22/83	7/21/88	
None	DOE	Injection	1/11/83	Open	(2)
SDS-77-2 (Docket #1)	LOC*	Air	9/9/77	Open	(3)

(1) Submitted for renewal (2/2/83).
(2) Letter of financial responsibility to LDNR to close, plug, and abandon any and all injection wells.
(3) Exemption from state air quality permitting requirements. Site is in a nonattainment area.

* LOC - Louisiana Office of Conservation

Table 3-2. Active Permits at Bayou Choctaw

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part of the ongoing cavern engineering program, individual workover permits are obtained for each procedure that is undertaken at the site through the Cavern Engineering Department. These work authorizations, from the Underground Injection Control Division in Louisiana, are limited to an individual operation per authorization. State inspectors regularly visit the site to observe drilling operations.

3.2.5 Ground Water

The SPR Geological Site Characterization Report prepared by Sandia National Laboratories (SNL) (publication number SAND80-7140) was consulted for information pertaining to the Plaquemine aquifer at the Bayou Choctaw site. This aquifer is the main source of fresh water for the site and several surrounding municipalities. It is located from approximately 60 feet below the surface to a depth of 500 to 600 feet. The upper 60 feet of sediments consist of Atchafalaya clay. The interface of freshwater/saline water occurs at a depth of 400 to 500 feet below the surface. Ground water in the Plaquemine aquifer flows away from the Mississippi during the high river stage and towards the river in the low stage.

At the Bayou Choctaw facility, two monitoring wells are located around the brine pond. One (sample station P1) is located on the north side, and the other (sample station P2) is located on the west side. There are no well logs or other background information on these wells.

The wells P1 and P2 were sampled intermittently. The low and high pH values for sample station P1 were 6.4 and 6.7. The low and high salinities were 9.0 and 23.0 ppt. The pH range of sample station P2 was 6.0 to 6.5. Salinity ranged from a low of 11.0 to a high of 40.0 ppt.

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The pHs observed for these two monitoring wells fall in the expected range for ground water in the Bayou Choctaw area. Past brining activity dating back to 1937 at the Bayou Choctaw site is suspected to have contributed to the elevated salinity values for both of the stations sampled.

3.2.6 Other Significant Environmental Activity

During 1984 the Bayou Choctaw environmental group initiated a program requiring submittal of material safety data sheets and other associated supplementary data by vendors prior to SPR purchase of chemical products. This program, which fulfills industrial hygiene, emergency response, warehousing, and waste disposal requirements, was subsequently adopted throughout the SPR. The Bayou Choctaw brine pond was cleaned of anhydrites followed by initiation of a program to reseal all concrete joints. Monitoring of the water wells for methane and ethane, which have apparently infiltrated the water table from a non-SPR source, was initiated along with planned remedial action.

3.3 BIG HILL

3.3.1 Monitoring

Drilling and site construction at the Big Hill site started in 1983 and continued through 1984. The NPDES permit obtained from EPA and the discharge permit from the State of Texas have provisions for a total of four outfalls. Brine discharges to the Gulf of Mexico (outfall 001) will be monitored for flow, oil and grease, TSS, TDS, and pH. There are design plans for six oil/water separators to discharge stormwater runoff from groups of well pads and pump pads to site drainage ditches. Figure 3-2 shows the planned outfalls and proposed monitoring locations. These will become discharge monitoring stations (collectively, outfall 003). Parameters to be monitored will include flow, total organic carbon (TOC), pH, and oil and grease. The

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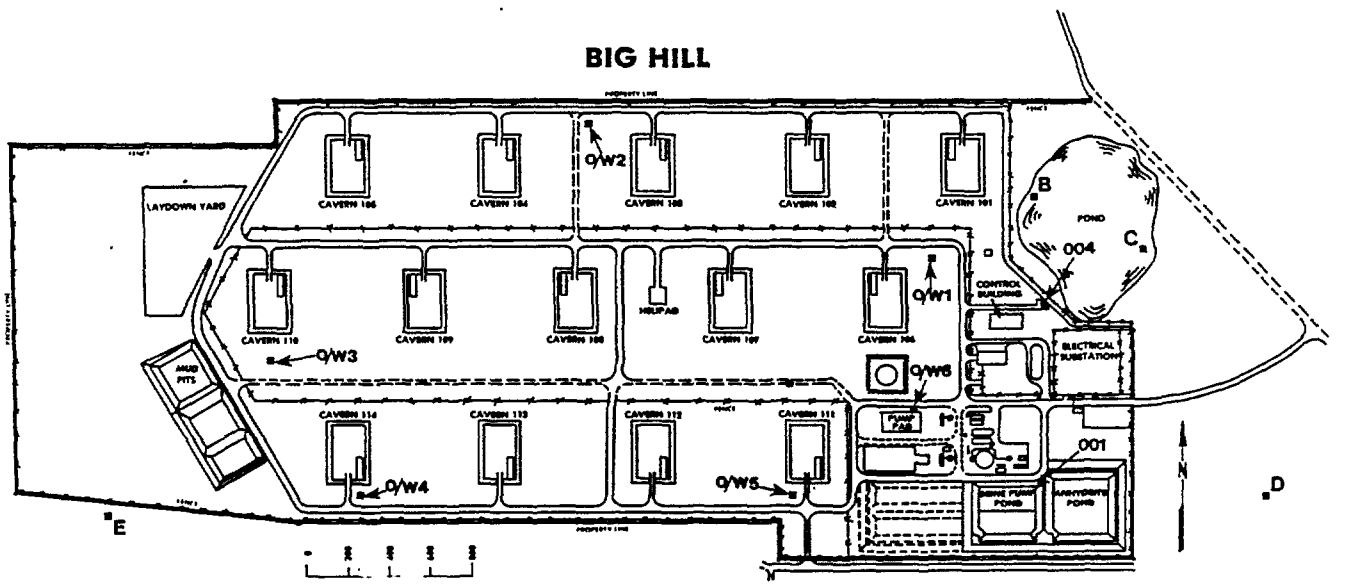

Figure 3-2 (Sheet 1 of 2). Big Hill Environmental Monitoring Stations

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Planned Discharge Monitoring Stations

001 Brine Disposal

002 Hydroclone and Blowdown at Raw Water Intake Structure

003 Stormwater Discharges

- O/W1 Stormwater from Well Pads 101, 102, 106
- O/W2 Stormwater from Well Pads 103, 107, 108
- O/W3 Stormwater from Well Pads 104, 105, 109, 110
- O/W4 Stormwater from Well Pads 113, 114
- O/W5 Stormwater from Well Pads 111, 112
- O/W6 Stormwater from Pump Pads

004 Discharge from Sewage Treatment Plants

Proposed Water Quality Stations

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

Figure 3-2 (Sheet 2 of 2). Big Hill Environmental Monitoring Stations

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discharge point for the sewage treatment units (outfall 004) will go directly into the 10-acre onsite pond. This pond has no normal discharge because evapotranspiration and rainfall rates are fairly equal. Pond overflow would be expected only during excessive rainfall and would flow south-southeast. Normal site drainage will flow downslope toward the southeast, south, and southwest. This general direction leads to the marshes south of the site.

At the onset of operations, selected locations will be established as monitoring stations to assess site-associated surface water quality and to provide early detection of surface water quality degradation that may occur as a result of SPR operations. Specific parameters to be monitored will probably include pH, salinity, alkalinity, temperature, TOC, DO, soluble iron, TDS, and TSS.

3.3.2 Active Permits

The Big Hill site is under construction. Permits specifically relating to construction, such as the Corps of Engineers (COE) permit and Texas Air Control Board (TACB) construction permit, as listed in Table 3-3, are all in order and current. There were no discharges and as such no noncompliances. The Federal Aviation Administration (FAA) notification for constructing the private-use only helipad is being renewed. Additional permits required for pipeline construction at highway and ditch crossings, such as issued by the State of Texas or Jefferson County, are of such short duration that their application will be made approximately three months prior to the specific pipeline crossing construction.

3.3.3 Ground Water

The SPR Geological Site Characterization Report, Big Hill Salt Dome (SNL publication number SAND81-1045) was used to obtain information on the ground water in the vicinity of Big Hill.

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PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
TX0092827	EPA	Water	1/18/84	1/17/89	
SWGCO-RP-16536	COE	Constr	1/11/84	1/10/87	
P-7	F&WS*	Constr Oper	1/84 1/84	12/85 12/2033	
83-ASW-178-NRA	FAA	Constr	4/83	12/84	(1)
C-9256	TACB	Air	5/17/83	Open	(2)
20-140-83	TDH&PT*	Constr	2/9/83	2/8/85	(3)
02937,8&9	RCT*	Oper	11/28/83	Open	(4)
0048106, 0048187, & 0048295 thru 0048320	RCT	Oper	5/9/83 6/23/83	Open Open	(5) (6)
02638	TDWR*	Water	6/27/83	6/26/88	
4045	TDWR	Water	11/18/83	Open	(7)

(1) Expired. Renewal submitted.
(2) Under construction. Conversion to operations permit should be made 6 months prior to site reaching full status.
(3) The amended and expired permit needs renewal. DOE responsible party.
(4) Valid until ownership changes, system changes, or other physical changes are made in the system.
(5) Individual permits to drill 28 wells. Nineteen complete, seven under construction, two to be drilled.
(6) Permits, in groups of two, to create, operate, and maintain an underground hydrocarbon storage facility consisting of 14 caverns.
(7) Construction must be started by 11/17/85. Permit expires after consumption of 239,000 acre-feet of water or end of project.

* F&WS - Fish and Wildlife Service
TDH&PT - Texas Department of Highways and Public Transportation
RCT - Railroad Commission of Texas
TDWR - Texas Department of Water Resources

Table 3-3. Active Permits at Big Hill

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The three major subsurface hydrological units in the Big Hill area are the Chicot and Evangeline aquifers and the Burkville Aquiclude. The major source of fresh water is the Chicot aquifer which lies over the Big Hill salt dome. Fresh water in the upper Chicot aquifer at Big Hill is limited from near the surface to a depth of less than -100 feet mean sea level (msl).

The town of Winnie uses fresh water from the upper Chicot aquifer, and the Beaumont/Port Arthur and Baytown areas withdraw their ground water from the lower Chicot aquifer.

There has been no ground water monitoring at the Big Hill site.

3.4 BRYAN MOUND

3.4.1 Air Quality

Bryan Mound operated in accordance with all air quality regulatory requirements throughout 1984. The ongoing monthly fugitive emissions monitoring program detected no leaks of hydrocarbon vapors from valves or pump seals. Storage tank emission calculations reflected the high crude oil throughput during 1984. A request to modify the monitoring frequency and tank emission calculation methodology specified in the Bryan Mound air quality permit was submitted to the TACB during 1984. These changes would bring the Bryan Mound permit requirements in line with current air regulations, methodologies, and the air quality permit requirements of the other Texas SPR facility. The TACB inspection conducted at Bryan Mound during 1984 found no deficiencies in SPR air quality compliance. Bryan Mound is located in a nonattainment area for ozone.

3.4.2 Surface Water Quality Monitoring

The surface waters surrounding the Bryan Mound site were monitored throughout 1984. Blue Lake was sampled monthly while Mud

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Lake was sampled monthly in April through August and in October of 1984. Because of wind and tidal induced flushing, no sampling could be performed in Mud Lake during January, February, March, September, November, and December.

Specific monitoring stations are identified in Figure 3-3. Stations A through C and E through G are located along the Blue Lake shoreline to facilitate monitoring the impact of site runoff. Station D, located farther out in Blue Lake, serves as a control station. Stations H and I are located along the Mud Lake shoreline to monitor site runoff impacts. Station J, located farther out in Mud Lake, also serves as a control station.

Specific parameters monitored in the Bryan Mound surface waters include pH, alkalinity, salinity, temperature, DO, TOC, COD, nitrite, nitrate orthophosphate, soluble iron, calcium, and magnesium. The parameters are discussed in turn with some comparisons to 1982 and 1983 monitoring data. The discussions are followed by summary observations.

3.4.2.1 Hydrogen Ion Activity (pH)

The hydrogen ion activity, or pH, was moderately basic, ranging from 7.2 in January to 9.9 in October in Blue Lake and 7.6 in June to 8.5 in May in Mud Lake. The upper pH criterion of 8.5 was exceeded 44 percent of the time by Blue Lake stations A through G and less than 1 percent of the time by Mud Lake stations H through J. The control stations for Blue Lake and Mud Lake exceeded the upper criterion pH of 8.5 for 33 percent and 17 percent of the observations respectively. The pH dropped below 8.0 for 29 percent of the observations in Blue Lake (January, February, and June) and 22 percent of the observations in Mud Lake (June and August). This is indicative of natural waters devoid of carbon dioxide and generally hard in regard to

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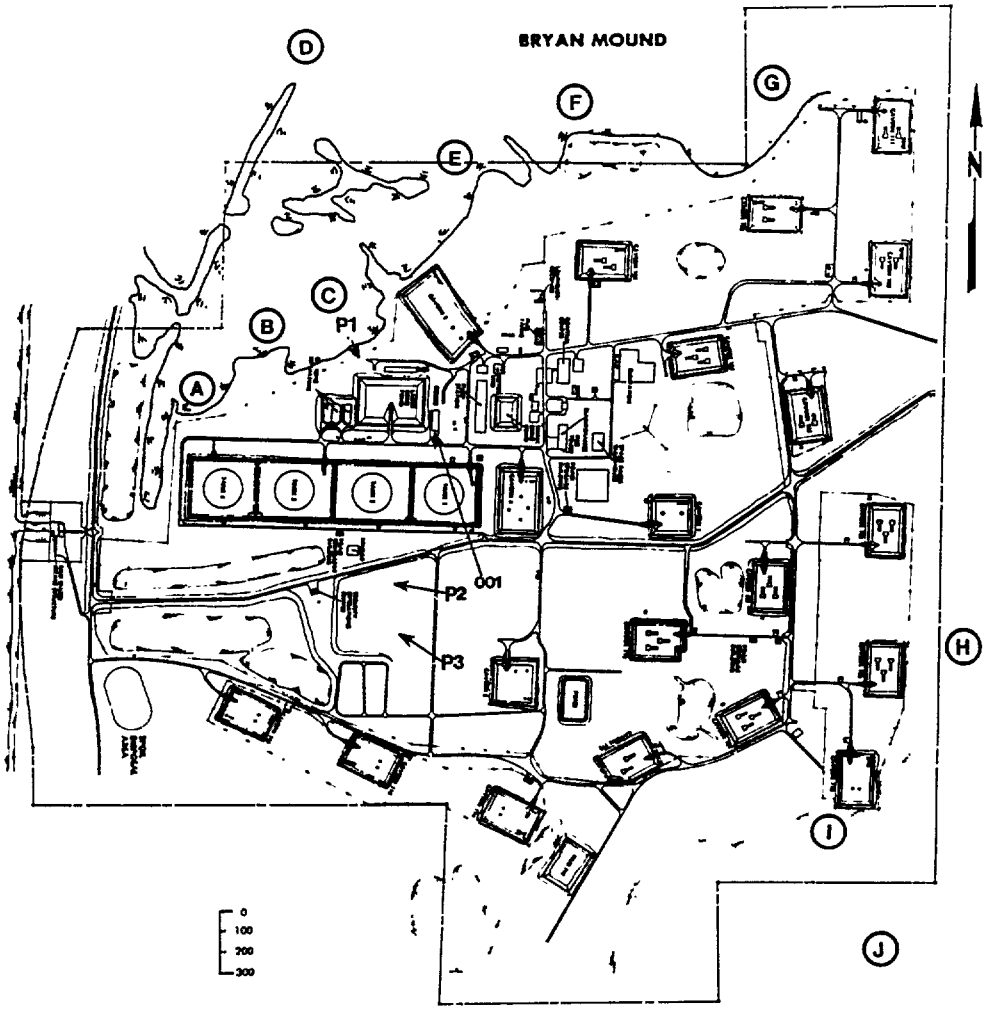

Figure 3-3 (Sheet 1 of 2). Bryan Mound Environmental Monitoring Stations

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Discharge Monitoring Stations

001 Discharge from Brine Surge Pit

002 Stormwater Runoff from Surge Tank Area (Corresponds to TX Water Comm. Permit No. 02271 Discharge 001)

Stormwater Discharges

Stormwater Runoff from Well Pad 1

Stormwater Runoff from Well Pad 2

Stormwater Runoff from Well Pad 4

Stormwater Runoff from Well Pad 5

Stormwater Runoff from Well Pad 101

Stormwater Runoff from Well Pad 102

Stromwater Runoff from Well Pad 103

Stormwater Runoff from Well Pad 104

Stormwater Runoff from Well Pad 105

Stormwater Runoff from Well Pad 106

Stormwater Runoff from Well Pad 107

Stormwater Runoff from Well Pad 108

Stormwater Runoff from Well Pad 109

Stormwater Runoff from Well Pad 110

Stormwater Runoff from Well Pad 111

Stormwater Runoff from Well Pad 112

Water Quality Monitoring Stations

A Blue Lake

B Blue Lake

C Blue Lake

D Blue Lake - Control Point 1

E Blue Lake

F Blue Lake

G Blue Lake

H Mud Lake

I Mud Lake

J Mud Lake - Control Point 2

Ground Water Monitoring

P1 Northwest Corner Brine Pond

P2 Between Laydown Yard & Levee Road

P3 Laydown Yard

Figure 3-3 (Sheet 2 of 2). Bryan Mound Environmental Monitoring Stations

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mineral content. Furthermore, the pH fluctuation may be affected seasonally by the rate of carbon dioxide uptake directly related to low primary productivity (low pH) in winter months and high primary productivity (higher pH) during summer months.

During 1982 and 1983 the pH measurements in Blue Lake and Mud Lake were observed to range from 7.7 to 10.1 and 7.7 to 10.2 respectively, in general agreement with the 1984 data. Thus, the pH fluctuation in the Bryan Mound surface waters appears to be a result of seasonal weather and tidal variations rather than site activity.

3.4.2.2 Alkalinity

Alkalinity, the capacity of water to neutralize an acid, generally reflects the activity of calcium carbonate in the water. The alkalinity in Blue Lake ranged from 48 mg/l in October to 199 mg/l as $CaCO_3$ in May, while the alkalinity in Mud Lake ranged from 112 mg/l in June to .154 mg/l as $CaCO_3$ in August. These levels of alkalinity, which provide some buffering capacity in the Bryan Mound waters, are in general agreement with the 1982 and 1983 observations.

3.4.2.3 Salinity

The salinity in Blue Lake ranged from 4.0 ppt from January through March and during December to 9 ppt August through October. Blue Lake was oligohaline (0.5 to 5 ppt) from January through March and during November and December and mesohaline (5 to 18 ppt) during the remaining months of 1984. This fluctuation in salinity was predominantly temporal with little spatial variation, suggesting it is seasonally or meteorologically induced rather than attributable to site operations. The salinities were more moderate during 1984 as in 1982 than during 1983, further suggesting that variation is at least partially attributable to meteorological factors.

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The salinity in Mud Lake ranged from 6 ppt in April to 31 ppt in August. Mud Lake was polyhaline (18 to 30 ppt) during all of 1984 with the exception of April when salinity in Mud Lake was mesohaline. The wider variation in Mud Lake salinity during 1984 as well as in previous years is attributed to the strong tidal and wind influence on this lake. Such variable conditions are expected to severely limit the species diversity in Mud Lake.

3.4.2.4 Temperature

The temperature in Blue Lake ranged from 9.0°C in January to 32°C in September. The temperature in Mud Lake ranged from 2.2°C in April to 29°C in July. No measurements were taken during the winter months in Mud Lake; therefore, no comparisons can be made with previous years. The spatial temperature variation within each lake was generally limited to 1°C or 2°C suggesting no site operationally induced thermal effects.

Comparable temperatures were observed during 1982 and 1983 when Blue Lake ranged from 17.3°C in December and 9°C in January to 32.8°C in August and 32.0°C in July, and Mud Lake ranged from 16.3°C in December and 15.1°C in February to 31°C in June and 32°C in July. These historical data show similar seasonal temperature fluctuations during 1982 and 1983 to those shown in 1984.

3.4.2.5 Dissolved Oxygen

The DO concentration in Blue Lake ranged from 16.0 mg/l in November to 5.3 mg/l in July. The DO in Mud Lake ranged from 9.7 mg/l in May (again no winter month sampling) to 2.75 mg/l in August. The DO dipped below the 5 mg/l criterion at stations H and I in July with all three stations (H, I, and J) below the 5 mg/l level in August and station J lowest. Because station J is the Mud Lake control station located the farthest from any SPR

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activity in the vicinity of Mud Lake, the low DOs experienced are attributed to seasonal factors and the tidal waters and lake morphology.

The observed DO levels in Blue Lake and Mud Lake were generally in excess of the minimum criterion of 5 mg/l. DO dropped below this level on two isolated occasions. Because the drop in DO occurred only in Mud Lake, the ecological impact should have been localized and, therefore, minimal. Only immotile aerobic organisms would have been affected by the temporary oxygen decline; however, this impact appears to have been short lived.

3.4.2.6 Total Organic Carbon

The TOC concentration in Blue Lake was relatively low, ranging from 5.1 mg/l to 20 mg/l throughout 1984 with the exception of March, May, June, and July. During this period, the TOC peak ranged from 23.8 mg/l to 32.2 mg/l for stations D, C, E, F, G, A, and B in a generally ascending order of TOC concentration.

The elevated TOC concentration observed in Blue Lake during May and June is attributed to a late spring phytoplankton bloom. The presence of plankton, and the soluble organic compounds they extrude during rapid growth, would be expected to raise the level of dissolved and particulate organic carbonaceous matter in Blue Lake. This in turn would result in elevated levels of TOC such as those observed. A similar spring elevation in TOC was observed in Blue Lake during May 1982 and during March and April of 1983.

The TOC concentration in Mud Lake remained relatively low throughout 1984 ranging from 5.6 mg/l to 17.7 mg/l. This stability can be somewhat explained for the tidal Mud Lake by its shallow nature and increased turbidity, which limit light penetration. Therefore, phytoplankton blooms would be expected

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to be smaller in comparison with Blue Lake; however, data were available for only six months.

The TOC concentration in both Blue Lake and Mud Lake in no case exceeded the TOC maximum criterion of 40 mg/l. This relatively stable and low TOC is indicative of a healthy ecosystem with a stable oxygen demand.

3.4.2.7 Chemical Oxygen Demand

The COD in Blue Lake ranged from nondetectable levels (less than 25 mg/l) in July, November, and December to 399 mg/l in February. All stations exhibited CODs of 100 mg/l or more in February, May, and June. The elevated COD levels during the warmer summer months are in agreement with the COD data observed during 1982 and 1983. This indicates that the oxygen demand attributable to chemically oxidizable matter increased during the more productive summer months. The high readings observed for February do not show any correlation with other parameters suggesting that the data represent an anomaly.

The COD observed in Mud Lake ranged from 101 mg/l in October to 828 mg/l in May. A more reduced temporal and spatial variability was observed during 1984 and 1982 than in Mud Lake during 1983. This variability is again attributed to the lake's tidal and morphological characteristics.

3.4.2.8 Macronutrients

The macronutrients, nitrate, nitrite nitrogen, and orthophosphate, were monitored in Blue Lake and Mud Lake throughout 1984. These parameters provide an indication of eutrophication in natural waters.

Nitrate is a necessary nutrient to the metabolism of plants. The nitrogen form is oxidized from the nitrite nitrogen intermediate. The nitrate concentration in Blue Lake ranged from 1.0

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mg/l during the months of March, July, October, and November to 3.5 mg/l in August. The nitrate concentration in Mud Lake ranged from 1.5 mg/l in May to 4.5 mg/l in August. These concentrations are sufficiently low to be of little concern for contact waters but sufficiently high to ensure the production of protein during primary production. Nitrite concentrations were low with nondetectable concentrations (less than 0.01 mg/l) occurring during all months except December in Blue Lake and during the six months sampled in Mud Lake. The detectable concentration in Blue Lake during December was 0.03 mg/l. This data is in agreement with the data from 1983.

Phosphate is a necessary nutrient to plant metabolism functioning in biochemical energy transfer. Phosphate, generally found in small quantities in natural waters, is commonly the limiting factor to plant growth (primary production). Phosphate in Blue Lake was observed to range from a low of 1.0 mg/l in July, October, and November to 17 mg/l during May. Mud Lake phosphate levels ranged from a low of 1.5 mg/l in July to a high of 27.0 mg/l in May. Elevated levels of phosphate were generally observed throughout most of the year in Blue Lake and Mud Lake. These elevated levels of phosphate are attributed to resident and migratory waterfowl such as American coot, ducks, geese, and pelicans which began frequenting Blue Lake and Mud Lake during August 1983. The phosphate concentration in natural waters is generally less than those concentrations observed in either Blue Lake or Mud Lake throughout 1984 and 1983. The atypically high levels of phosphate observed without a sustained phytoplankton bloom are indicative of primary production being limited by a factor other than phosphate.

3.4.2.9 Cations

The total soluble iron, calcium, and magnesium cations were monitored throughout 1984. Total soluble iron was observed at

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less than 1 mg/l in over 90 percent of the samples for Blue Lake. A maximum of 1.4 mg/l was observed in April. Mud Lake iron observations were between 0.91 mg/l and 5.7 mg/l. The low iron levels observed in Blue Lake are typical for natural waters and sufficient to support the indigenous organisms. The iron levels observed in Mud Lake are high for natural waters but consistent with the 1982 and 1983 Mud Lake observations which averaged 2.6 mg/l and 1.7 mg/l respectively. The iron levels in Mud Lake are attributed to its basin geochemistry and the water influx from the Intracoastal Waterway.

Calcium and magnesium, essential micronutrients to plants and animals, are commonly the principal contributors to water hardness. Calcium ranged from 86 mg/l (November) to 197 mg/l (September) in Blue Lake and 296 mg/l (October) to 378 mg/l (August) in Mud Lake. This distribution of relative calcium concentrations is in general agreement with the temporal distribution of pH during 1984. The pH induced shift of inorganic carbon from the bicarbonate to carbonate form and the seasonally induced biochemical utilization of calcium may account for the observed calcium ion fluctuations which were similar in 1983. Magnesium ranged from 94 mg/l (February) to 273 mg/l (October) in Blue Lake and 610 mg/l (June) to 1136 mg/l (August) in Mud Lake. These relatively high concentrations of calcium and magnesium in Blue Lake are consistent with 1982 and 1983 observations; however, the concentrations in Mud Lake increased by a factor of two to three times over the 1982 and 1983 observations.

3.4.2.10 General Observations

Based on the above discussion, the following general observations are made regarding the quality of Bryan Mound surface waters.

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a. The temperature remained higher longer in 1984 than in 1983. This, in part, is attributed to no hurricanes and very little rainfall until November. The pH dropped in June and in January and February which may be attributed to winds mixing CO_2 into the surface water and a decline in primary productivity, respectively.

b. The observed pH was high but stable in Blue Lake and Mud Lake. This is consistent with the alkalinity and relative water hardness observed. These factors would tend to buffer any pH related pollution incidents.

c. The January/February brine spill into Blue Lake appears to have had no measurable impact on that ecosystem. The undetermined but small amount of brine was allowed to mix naturally with lake waters. Specific water quality parameters, especially salinity, showed no temporal or spatial variation attributable to this spill, suggesting normal water movement (wind and tide induced) was effective in mitigating small spills.

d. Mud Lake appeared to be of lesser quality than Blue Lake as suggested by elevated macronutrient and micronutrient levels. The more direct communication of Mud Lake with the Intracoastal Waterway and the frequent wind and tidal induced flushing are considered causative factors in the data variability in Mud Lake.

3.4.3 Water Discharge Permit Monitoring

Water discharges at Bryan Mound are regulated and enforced through EPA's NPDES Permit Program and TDWR's discharge permit, which generally corresponds to the federal permit. The two categories of discharges are brine to the Gulf of Mexico and stormwater discharges from the tank farm, well pads, and pump pads. There is no sewage treatment plant on the site.

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Parameters measured from the brine and stormwater discharges are listed below with their maximum limits.

Location/Discharge	Parameter	Maximum Value
brine discharge to Gulf	flow	1.1 million barrels/day (velocity $\geq$ 20 f/s)
	oil and grease	15 mg/l
	TDS	(report)
	TSS	(report)
stormwater discharges	flow	(report)
	oil and grease	15 mg/l
	TOC (EPA only)	75 mg/l
	pH	$\geq$ 6.0 - $\leq$ 9.0 units
	COD (Texas only)	200 mg/l

Of 344 brine discharges to the Gulf of Mexico from the brine pond, there was only one noncompliance. The remaining 558 discharges were within permit limitations giving the site a compliance level of more than 99.9 percent.

The Bryan Mound site has a second permit from TDWR for the appropriation of state waters for the leaching program, site use, and fire protection systems. The permit requires a yearly update of the quantity of water used. In 1984 the site appropriated 31,941.36 acre-feet of water from the Brazos River Diversion Channel.

3.4.4 Active Permits

Table 3-4 lists the active permits for the Bryan Mound site. There was only one noncompliance incident for 1984. The noncompliance resulted from site operators forgetting to take the daily sample from outfall 001 and the high pressure pump pad on a weekend shift. Samples taken prior and subsequent to the omission were within permit limitations.

The permit SWGCO-RP-16177 is for construction of a potable water line from a City of Freeport tie-in to the site. Associated

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PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
TX0074012	EPA	Water	2/3/84	2/2/89	
SWGCO-RP-12347(1)	COE	Dredging	2/22/78	12/31/94	(1)
SWGCO-RP-16177	COE	Constr.	9/7/82	7/1/85	(2)
3-67-782 (Docket#)	RCT	Injection	8/21/78	Open	(3)
3-70-377 (Docket#)	TDWR	Injection	12/18/78	Open	(3)
3681A	TDWR	Water	7/30/79	Open	(4)
02271	TDWR	Water	2/3/84	2/2/89	(5)
C-6176B	TACB	Air	7/20/79	Open	(6)
82-8475	TDH&PT	Constr.	1/1/83	10/10/84	(7)
None	Brazoria Cy.	Constr.	12/22/82	6/21/83	(7)

(1) Two-week prior written notification to District Engineer required.
(2) Construction must be started by 7/1/85 and be completed by 12/31/85.
(3) Approval of oil storage and salt disposal program.
(4) Permit expires after consumption of 367,088 acre-feet of water or project ends.
(5) Corresponds with TX0074012.
(6) Conversion to operations permit should be made 6 months prior to site reaching full status. Modification to existing permit submitted.
(7) Corresponds with SWGCO-RP-16177. Needs reapplication 3 months prior to planned construction.

Table 3-4. Active Permits at Bryan Mound

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permits are from the TDH&PT and Brazoria County. The project has been delayed; however, within four months of its planned construction, reapplications will be made to the Corps of Engineers and TDH&PT. Brazoria County will be approached for a new permit approximately one month prior to start of construction.

3.4.5 Ground Water

Information on the ground water at the Bryan Mound site was obtained from the SPR Geological Site Characterization Report, Bryan Mound Salt Dome (SNL publication number SAND80-7111) and the Final Environmental Impact Statement (publication number DOE/EIS-0021). The Chicot and Evangeline aquifers are the only two hydrological units that provide fresh or slightly saline water to the Bryan Mound area. (However, wells drilled onsite for potable water have all been brackish.) The Brazoria County fresh water source is the upper unit of the Chicot aquifer. Fresh water is conjectured to occur in the upper 80 feet of the aquifer over the salt dome with slightly saline water from 80 to approximately 225 feet.

There are three monitoring wells (P1, P2, and P3) on the site. The locations of these wells are:

a. P1 - northwest corner of brine pond.
b. P2 - northeast of well 3 (between laydown yard and levee road.
c. P3 - southeast of well 3 (laydown yard).

These locations are identified in Figure 3-3. The monitoring wells have been sampled since 1982; however, there is no well log history or background information on their construction or installation. The wells are sampled monthly.

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During calendar year 1984, the pH of well P1 ranged from 5.96 to 6.93. Salinity ranged from 8.0 ppt in February to 118.0 ppt in June. COD ranged from 45.0 mg/l in April to 368.5 mg/l in May. P2 exhibited a low pH of 6.30 in late June ranging to 7.71 in January. Salinity ranged from 6.0 ppt in March to 8.0 in November. COD ranged from less than 25.0 mg/l in December to 380.5 mg/l in February. The pH for P3 ranged from 6.16 to 7.52. Salinity ranged from a low of 8.0 ppt to 33.0 ppt, and COD ranged from 32.0 mg/l to 828.0 mg/l.

The interconnection of the aquifers and the proximity to salt domes contribute to the salinity variation. Monitoring of these wells will continue in order to establish a baseline for future study.

3.4.6 Other Significant Environmental Activity

During 1984 the Bryan Mound Environmental group undertook direct responsibility for inspection and maintenance of the offshore brine line diffusers and buoys negating the need and expense of previous contract offshore support. In response to the Railroad Commission of Texas' amendment to rule 8, Bryan Mound permitted its existing brine pits and closed the anhydrite disposal pit. Bryan Mound activated a redesigned fish ladder facilitating the safe return of aquatic organisms removed from the intake structure traveling screens to the Brazos River. The site laboratory undertook monitoring of the site utility water for fecal coliforms in response to repeated treatment unit bypasses by the Freeport Municipal Sewage Plant located upstream of the SPR's water intake on the Brazos River. Elevated levels of fecal coliforms in the site utility water were observed on several occasions, and appropriate hygienic precautions were undertaken by site management.

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3.5 ST. JAMES TERMINAL

3.5.1 Air Quality

St. James Terminal operated in accordance with all air quality permit and regulatory requirements during 1984. St. James is located in a nonattainment area for ozone. There was no tanker activity at St. James in 1984. Oil movements were limited to intersite pipeline pigging operations and a 24-hour drawdown exercise at each of the connected storage sites (Bayou Choctaw and Weeks Island). Thus hydrocarbon emissions were well below the levels projected in the St. James Emission Inventory Questionnaire.

3.5.2 Surface Water Quality Monitoring

St. James Terminal is located in a low-lying agricultural area outside of the west levee of the Mississippi River. All precipitation is effectively drained from the terminal and surrounding sugar cane fields by a series of ditches. There are no permanent natural water bodies in the vicinity of St. James Terminal. Thus, the lack of potentially impacted surface waters precludes the need for surface water quality monitoring at St. James.

The two St. James docks are located on the west bank of the Mississippi River. They are curbed with all runoff pumped to the terminal's stormwater treatment system and retention pond. The site retention pond, which also collects stormwater runoff from the six crude oil storage tank containment areas, is discharged intermittently through outfall 001 (Figure 3-4) into the Mississippi River. Two wastewater treatment plants, which serve the site control and maintenance buildings, discharge as 002 and 003 through outfall 001 into the Mississippi River.

At St. James, the Mississippi River has a large flow volume, a high current, and a strong assimilative capacity. Thus, the

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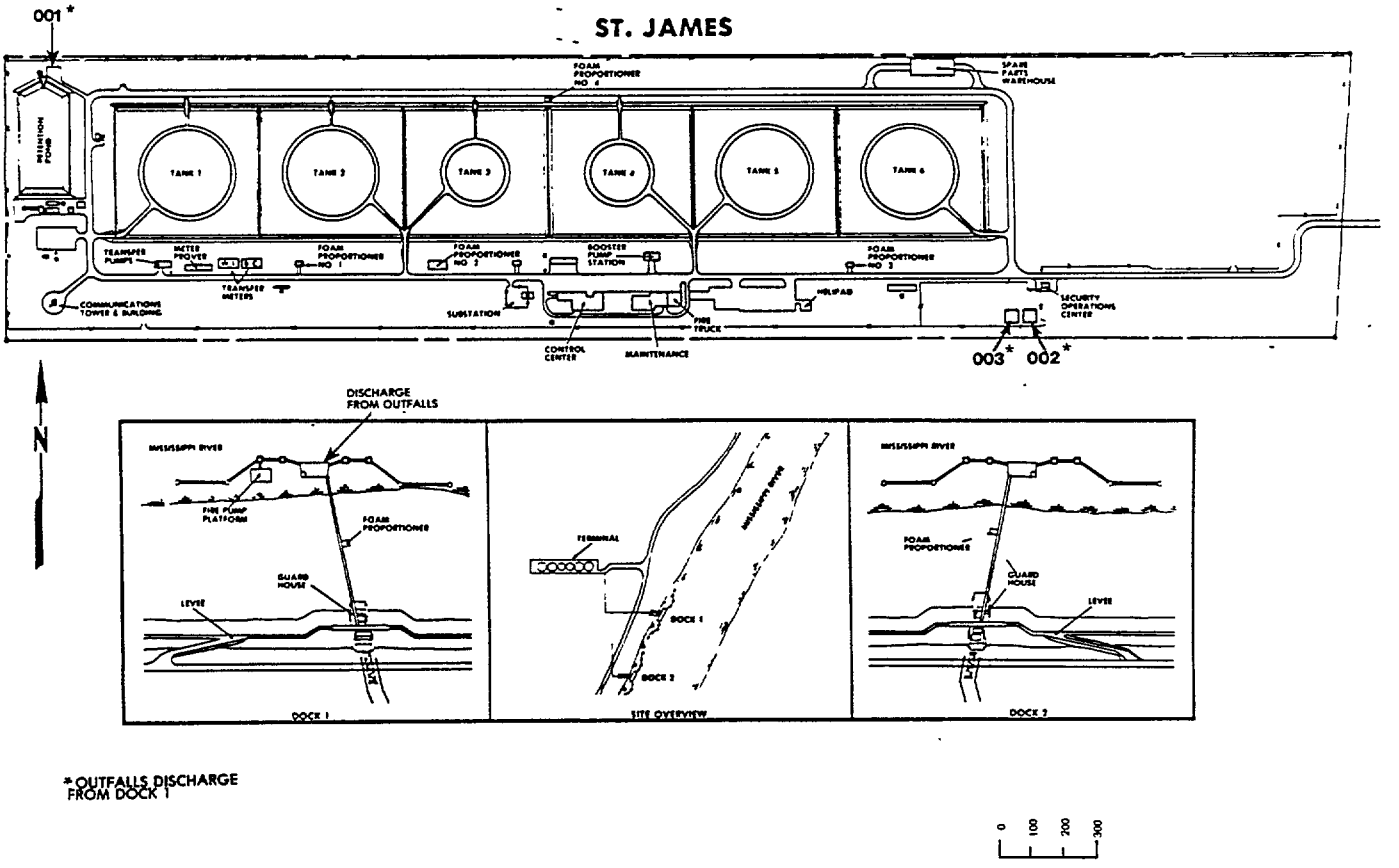

*OUTFALLS DISCHARGE FROM DOCK 1

Figure 3-4 (Sheet 1 of 2). St. James Terminal Environmental Monitoring Stations

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Discharge Monitoring Stations

001	Discharge from Retention Pond
002*	Discharge from Package Sewage Treatment Plant
003*	Discharge from Package Sewage Treatment Plant

* State discharge permit outfall numbers.

Figure 3-4 (Sheet 2 of 2). St. James Terminal Environmental Monitoring Stations

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intermittent nature of discharges from site outfalls, the characteristic hydrographic features of the Mississippi River at that point, and an ongoing state-conducted water quality monitoring program limit the value of a site-directed water quality monitoring program in the Mississippi River.

3.5.3 Water Discharge Permit Monitoring

The discharge of stormwater from the site retention pond (outfall 001) is the only water discharge regulated by the EPA under their NPDES permit. The Louisiana Department of Environmental Quality (LDEQ) has also issued a water discharge permit for the site which includes outfall 001 with 002 and 003, the latter two from the two site package sewage treatment plants. All individual discharges are commonly piped to the Mississippi River.

Parameters measured from the outfalls are listed below, along with their maximum limits.

Location/Discharge	Parameter	Maximum Value
retention pond	flow	(report)
	oil and grease	15 mg/l
	pH	$\geq$ 6.0 - $\leq$ 9.0 units
	TOC	55 mg/l (EPA)
		50 mg/l (state)
sewage treatment plants	flow	(report)
	BOD_5	45 mg/l
	TSS	45 mg/l
	pH	$\geq$ 6.0 - $\leq$ 9.0 units

All 34 required analyses made on the site discharges were within permit limitations resulting in a 100 percent compliance level for 1984.

3.5.4 Active Permits

Table 3-5 lists the active permits at St. James Terminal. There were no permit noncompliances during 1984.

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PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0054674	EPA	Water	5/26/80	5/25/85	(1)
LMNOD-SP (Miss. R)998	COE	Dredging	3/20/78	3/19/88	(2)
WP 9829	LDEQ	Water	9/26/84	9/26/89	
983	LACC*	Air	7/25/78	Open	(3)

(1) Renewal submitted March 1985.
(2) Two-week prior written notification to District Engineer required.
(3) Requires annual operating report.

* LACC - Louisiana Air Control Commission

Table 3-5. Active Permits at St. James Terminal

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3.5.5 Ground Water

Information used concerning the regional ground water close to the St. James Terminal was from the Final Environmental Impact Statement, Strategic Petroleum Reserve, Capline Group Salt Domes (publication number DOE/EIS-0024). No site specific information detailing the ground water at St. James Terminal has been developed.

The Chicot aquifer is the principal regional aquifer at St. James. The ground water contained in this aquifer is slightly saline. In the St. James area only the uppermost units contain fresh water. The upper strata of the Chicot aquifer is in direct hydrologic contact with the Mississippi River.

3.5.6 Other Significant Environmental Activity

The temporary aboveground fuel tanks were replaced by permanent buried fuel tanks during 1984. An Emergency Response Equipment Storage Bay was established as a centralized location for all environmental, safety, and fire protection equipment needed for onsite emergency responses. This will simplify site emergency response procedures, thereby increasing response effectiveness.

3.6 SULPHUR MINES

3.6.1 Air Quality

Sulphur Mines operated in accordance with all air quality permit and regulatory requirements during 1984. This SPR site is located in a nonattainment area for ozone. There were no configurational or operational changes at Sulphur Mines which would alter the site's emission rates. No air quality monitoring was conducted during 1984.

In June of 1984 a revised Emission Inventory Questionnaire and a comprehensive Report of Actual Emissions were provided to the

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Louisiana Air Control Commission. Emissions of hydrocarbons from the brine pond, slop oil tank, pump seals, and valves totaled 9.4 tons from 1979 to 1984. Emissions of hydrocarbons are projected at 0.2 tons per year while the site continues in the current static mode and 0.5 tons per year when crude oil withdrawal is undertaken. These emission rates are minor in terms of the area's petrochemical industry.

3.6.2 Surface Water Quality Monitoring

Water quality monitoring at the Sulphur Mines site was generally conducted on a weekly to monthly basis throughout 1984. To ensure temporal consistency across data comparisons, the weekly data were reduced to monthly averages (except pH which was reduced to monthly minimums and maximums). Specific monitoring stations are identified in Figure 3-5 by stations A and B in site drainage, station C in the subsidence area, discharge stations D and E in site impoundments, station F at the site raw water intake structure, and station G in the subsidence area. Station C was only monitored in January and February. Station G was not monitored in January and March. Specific parameters monitored in the Sulphur Mines surface waters include pH, salinity, TDS, TSS, temperature, and oil and grease. These data are discussed by temporal and spatial relationships, including comparisons with 1982 and 1983 data, followed by summary observations.

3.6.2.1 Hydrogen Ion Activity (pH)

The median pH was 6.4 ranging from a low of 4.4 at station A in June to a high of 8.4 at station E in March. This data is in close agreement with the pH ranges of 3.5 at station A to 8.5 at station E during 1982 and 3.6 at station A to 8.5 at station E during 1983. The minimum and maximum pHs occurred during June and March respectively during 1983 and 1984. The general pH tended to be slightly acidic at stations A and B with median pHs of 6.2 and 6.7 respectively. Stations C, D, E, and F were neutral to

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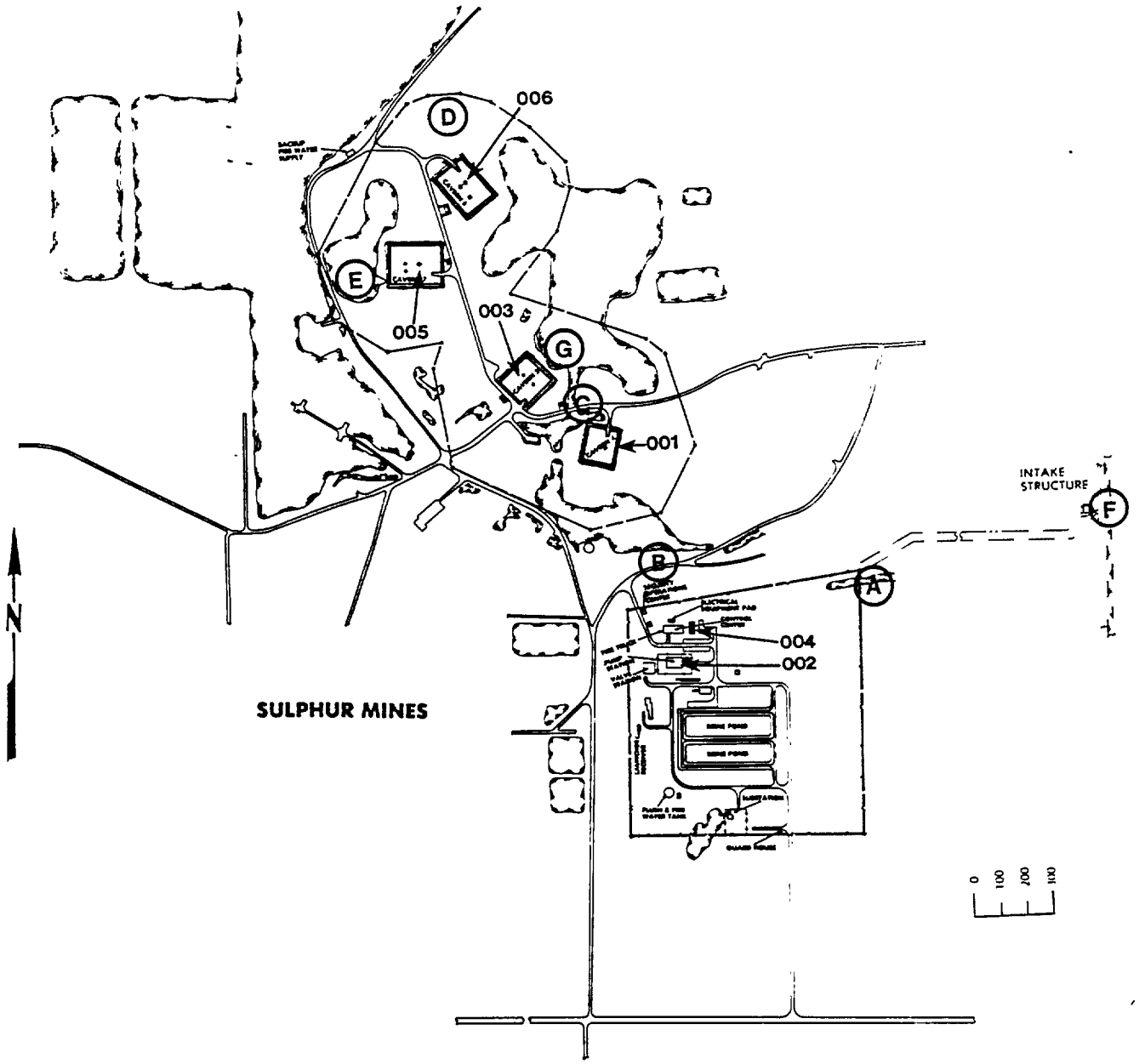

Figure 3-5 (Sheet 1 of 2). Sulphur Mines Environmental Monitoring Stations

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Discharge Monitoring Stations

001 Stormwater Runoff from Well Pad 4
002 Stormwater Runoff from Pump Station
003 Stormwater Runoff from Well Pad 2
004 Discharge from Sewage Treatment Plant
005 Stormwater Runoff from Well Pad 7
006 Stormwater 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

Figure 3-5 (Sheet 2 of 2). Sulphur Mines Environmental Monitoring Stations

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slightly basic with respective median pHs of 7.4, 7.1, 7.8, 7.3, and 7.4. Low pHs were generally observed during January and February at stations A, B, and D and during March, May, June, July, and August at station A.

Low pH is characteristic of natural waters dominated by the carbon dioxide and bicarbonate forms of inorganic carbon. Such waters may generally be characterized as soft in regard to mineral content. The characteristically low pH at station A was observed to become more extreme during low flow in this drainage ditch suggesting that pH is affected by a local geochemical process or through the addition of proportionally greater quantities of pollutants. Outfall 004, the site sewage treatment plant which discharges upstream of station A, was within compliance for pH throughout 1984 and was, thus, not considered a significant factor in the observed low pHs. Geochemical processes are considered the most likely cause of the generally acidic conditions observed at Sulphur Mines.

3.6.2.2. Salinity

The average salinity of the surface waters at Sulphur Mines was generally oligohaline (0.5 to 5 ppt), with the exception of station F, which was limnetic (less than 0.5 ppt) throughout 1984. Mesohaline (5 to 18 ppt) salinities were observed only at station G from April to June and August to October.

The limnetic waters observed at station F throughout 1984 were consistent with the 1982 and 1983 observations. These waters are part of the local flood control canal system and are separate from the local Sulphur Mines surface drainage. Stations A through E and G averaged 2.4 ppt throughout 1983 with the highest annual average salinity observed at station G, the subsidence area. This was consistent with 1982 and 1983 observations and is attributed to the years of mining activity at this salt dome which dates to development of the first Frasch sulfur mine at this location.

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3.6.2.3 Total Dissolved Solids

TDS levels were observed at 2 to 27 times the fresh water criterion (500 mg/l) for stations A through E and G. The limnetic station F did not exceed the fresh water TDS criterion throughout 1984. This indicates that the high TDS levels at stations A through E are at least partially attributable to salinity. Least squares regression analysis produced a strong correlation ($r=0.97$, $n=58$) between salinity and TDS supporting the contention that salinity is the dominant factor contributing to the observed TDS concentrations. Similar relationships were observed during 1982 and 1983.

3.6.2.4 Total Suspended Solids

The monthly TSS levels exceeded the site criterion of 30 mg/l fifteen times (21 percent of the determinations) by an average of 12.1 mg/l during 1984. This is consistent with TSS observations made during 1982 and 1983. Stations A and G were the most frequent locations of observed high levels of TSS (four occasions each). However, all site stormwater discharges were within compliance throughout 1984 and, thus, did not significantly affect the ambient characteristics of the water quality monitoring stations.

3.6.2.5 Temperature

The observed temperatures of the Sulphur Mines surface waters were within the site criterion of 32°C throughout 1984. The maximum station temperatures (averaging 24.1°C) were observed during May, June, July, and August, while the minimum temperatures (averaging 11.7°C) were observed during January and February. This moderate temperature distribution, which temporally approximates the 1982 and 1983 observations, averages about 2°C cooler than the 1983 observations.

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3.6.2.6 Oil and Grease

Nondetectable levels of oil and grease (less than 5 mg/l) were observed on all but two occasions during 1984. Stations B and E had detectable levels of 6.1 mg/l and 6.6 mg/l oil and grease during January and February respectively. All discharges potentially affecting station B in January and station E in February had nondetectable levels of oil and grease. Furthermore, the water quality at stations B and E is subject to the effects of discharges by other residents of the Sulphur Mines salt dome. Thus, the observed detectable levels of oil and grease at stations B and E are not likely the result of SPR activities at Sulphur Mines.

3.6.2.7 General Observations

Based on the above discussion, the following general observations are made regarding the quality of Sulphur Mines surface waters.

a. The generally consistent temporal and spatial pH distribution from 1982 through 1984 suggests that the slightly acidic water quality conditions at Sulphur Mines are attributable to geochemical and meteorological conditions.

b. The general 2°C decline in water temperature observed during 1984 relative to 1983 is attributed to meteorological variation.

c. The high TDS level observed in Sulphur Mines surface waters was attributed to the characteristic oligohaline waters during 1984, as during previous years.

d. Detectable levels of oil and grease were observed on two occasions during 1984. However, examination of site discharge data showed that these elevated oil and grease levels were not attributable to SPR site activity.

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3.6.3 Water Discharge Permit Monitoring

The six water discharge points at Sulphur Mines are regulated and enforced through the EPA's NPDES program. Five of the discharges are stormwater runoff from the well pads and pump pad (outfalls 001, 002, 003, 005, and 006); the sixth (outfall 004) is the effluent from the package sewage treatment plant.

Parameters analyzed from the stormwater and wastewater discharges are listed below along with their maximum limits.

Location/Discharge	Parameter	Maximum Value
stormwater	flow	(report)
	oil and grease	15 mg/l
	pH	$\geq$ 6.0 - $\leq$ 9.0 units
sewage treatment plant	flow	(report)
	BOD_5	45 mg/l
	TSS	45 mg/l
	pH	$\geq$ 6.0 - $\leq$ 9.0 units

A total of 173 samples from the various discharges were analyzed. None of the parameters exceeded the permit limitations; thus, Sulphur Mines had 100 percent permit compliance throughout 1984.

3.6.4 Active Permits

There were no noncompliances at the Sulphur Mines site during 1984 for any of the permits listed in Table 3-6. The saltwater disposal wells are routinely exercised, and all state underground injection control certifications are current. The required and obtained one-time work authorizations for the individual wells are handled by the Cavern Engineering Department. State inspectors regularly visit the site to observe underground injection operations.

3.6.5 Ground Water

The SPR Geological Site Characterization Report, Sulphur Mines Salt Dome (SNL publication number SAND80-7141) and the Final

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PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0055786	EPA	Water	4/12/80	4/11/85	(1)
1042	LACC	Air	9/26/78	Open	(2)
None	LDOTD*	Water	12/14/83	12/31/85	(3)
None	LDNR	Injection	1/11/83	Open	(4)
SDS-6 (Order #1)	LOC	Injection	7/20/78	Open	(5)

(1) Renewal submitted March 1985.
(2) Requires annual operating report.
(3) Water purchase agreement.
(4) Letter of financial responsiblity to close, plug, and abandon any and all injection wells.
(5) Approval for use of salt dome cavities for storage of liquid hydrocarbons.

* LDOTD - Louisiana Department of Transportation and Development

Table 3-6. Active Permits at Sulphur Mines

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Environmental Impact Statement (publication number DOE/EIS-0029) were referenced to obtain information concerning ground water in the vicinity of Sulphur Mines.

The main aquifers in the vicinity of Sulphur Mines are the Chicot, Evangeline, and Jasper. The Chicot aquifer provides a fresh water source for public and industrial use to the towns of Hackberry, Lake Charles, and Sulphur. The steady pumping and the large quantities of water pumped from the Chicot aquifer have created a large core depression in the Chicot aquifer. The Evangeline and Jasper as well as other aquifers in the vicinity of the site are saline. The Evangeline aquifer is used for salt water disposal in the Lake Charles area.

There are no monitoring wells on the Sulphur Mines site.

3.7 WEEKS ISLAND

3.7.1 Air Quality

Weeks Island operated in accordance with all air quality permit and regulatory requirements during 1984. There were no configurational or operational changes at Weeks Island which would alter the site's emission rates. No air quality monitoring was conducted during 1984.

A revised Emissions Inventory Questionnaire and comprehensive Report of Actual Emissions were provided to the Louisiana Air Control Commission in January 1984. From 1980 to 1984, emissions of hydrocarbons from valves and pump seals totaled 187 pounds while emissions of sulfur dioxide from the flare stack totaled 74 pounds. Installation of a meter skid and prover loop with air eliminator valves in 1983 has added considerably to the hydrocarbon emission rates. Emissions of hydrocarbons are projected at 0.7 tons per year during crude oil withdrawal, 0.3 tons per year during site filling operations, and 1.0 ton per year from the

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projected recirculation program designed to ensure operational readiness. Emissions of sulfur dioxide are expected to be limited to withdrawal operations at a rate of 76 pounds per year. These low emission rates are expected to have a minor impact by comparison to the atmospheric emissions of the salt cake and chemical plants operated by Morton Salt Company at Weeks Island.

3.7.2 Surface Water Quality Monitoring

The Weeks Island site is located on the Weeks Island salt dome approximately 100 feet above sea level. The surrounding topography is of rather sharp relief with several small lakes. None of the SPR outfalls discharge into these lakes. Other surface waters at this site are intermittent in nature, draining rapidly and thoroughly after any precipitation. The site outfalls (001A, 001B, and 002, shown on Figure 3-6) discharge small volumes into surface drainage a substantial distance from receiving waters. Thus, the lack of potentially impacted surface waters precludes the need for surface water quality monitoring at the Weeks Island site.

3.7.3 Water Discharge Permit Monitoring

The water discharges at Weeks Island are regulated and enforced in accordance with the EPA's NPDES permit program. Two of the site's discharges (outfalls 001B and 002) are the effluent from package sewage treatment plants. Outfall 001A is stormwater runoff collected in an onsite retention pond.

The various parameters analyzed from the monthly samples of all three discharges are listed below with their maximum limits.

Location/Discharge	Parameter	Maximum Value
stormwater	flow	(report)
	oil and grease	15 mg/l
	pH	$\geq$ 6.0 - $\leq$ 9.0 units

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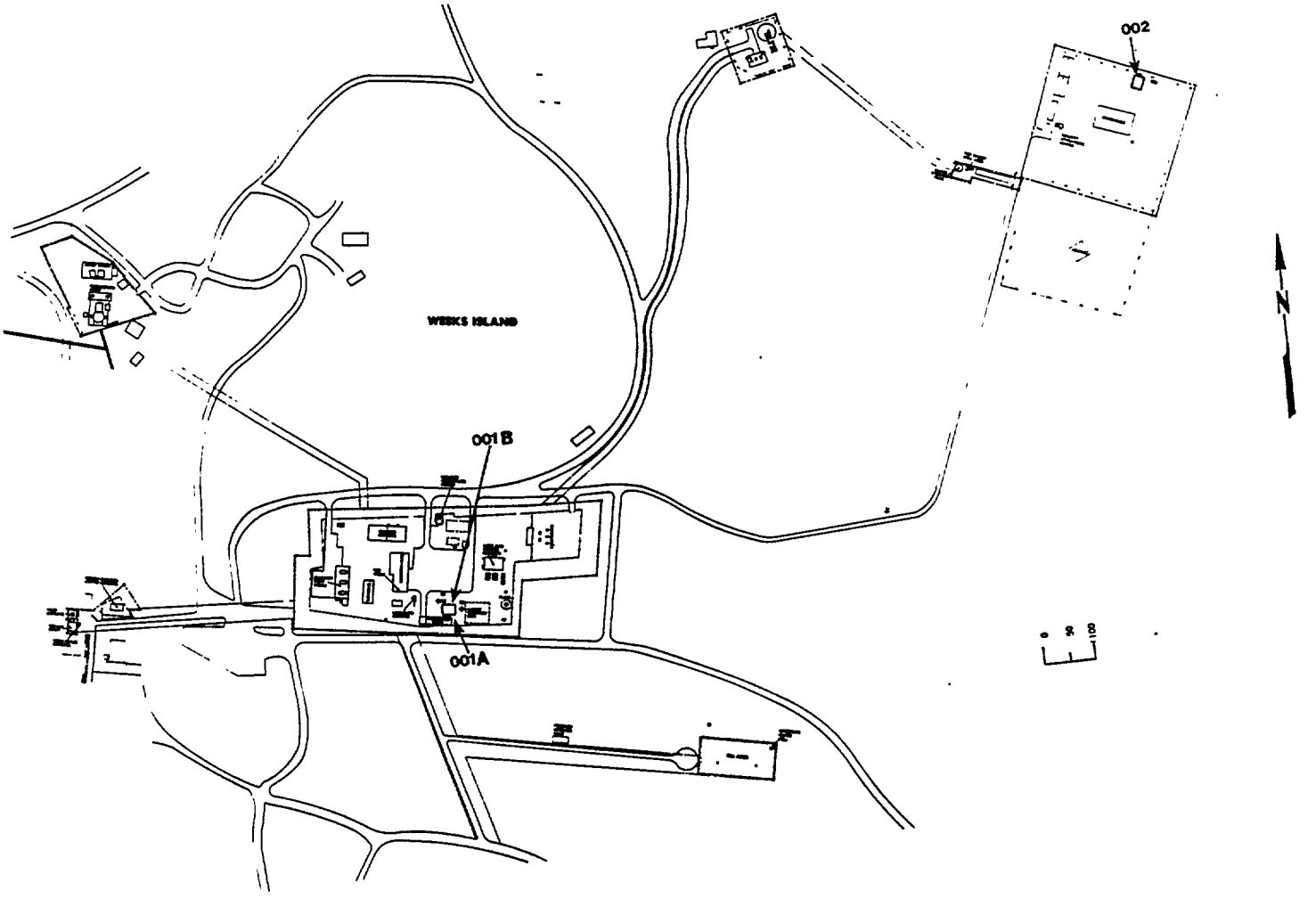

Figure 3-6 (Sheet 1 of 2). Weeks Island Environmental Monitoring Stations

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Discharge Monitoring Stations

001A Stormwater Runoff
001B Discharge from Sewage Treatment Plant
002 Discharge from Sewage Treatment Plant

Figure 3-6 (Sheet 2 of 2). Weeks Island Environmental Monitoring Stations

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Location/Discharge	Parameter	Maximum Value
sewage treatment plant	flow	(report)
	BOD_5	45 mg/l
	TSS	45 mg/l
	fecal coliforms	400 colonies/100 ml
	pH	$\geq$ 6.0 - $\leq$ 9.0 units

The NPDES permit requires 120 analyses conducted from the 36 samples taken annually. There were two noncompliances in 1984, one for each of the sewage treatment plants. These noncompliances, on an individual parameter basis, resulted in a site compliance performance level of 98 percent compliance during 1984.

3.7.4 Active Permits

The Weeks Island site had two noncompliances during 1984 relating to permit limitations in LA0056243, outfalls 001B and 002 (Table 3-7). Both of these are sewage treatment plant discharges. The first (001B) occurred in January, and the TSS overload (60 mg/l) was attributed to the abnormally cold temperatures which inhibited bacterial activity. The other noncompliance, from outfall 002, was also a high TSS value (35 mg/l) but attributed to an above average number of subcontractor personnel temporarily on site. All other permit-related activity was in compliance.

3.7.5 Ground Water

As indicated in the referenced document, the SPR Geological Summary Report (SNL publication number SAND80-1323), the Chicot formation is the principal aquifer in the Weeks Island area. The aquifer surface is approximately at sea level near Weeks Island and slopes slightly northwest towards an island depression. This island depression was caused by heavy withdrawals around Lake Charles. Some of the upper sand layers in the Chicot aquifer contain fresh water as well as saline water at approximately 300 to

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PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENT
LA0056243	EPA	Water	6/30/79	10/13/87	
1105	LACC	Air	1/30/78	Open	(1)
SDS-8 (Order #1)	LOC	Injection	2/16/79	Open	(2)
None	LDNR	Water	7/12/79	Open	

(1) Requires annual operating report.
(2) Approval for use of salt dome cavities for storage of liquid hydrocarbons.

Table 3-7. Active Permits at Weeks Island

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600 feet below the surface. The fresh water sand layers provide water for the local area.

There are no ground water monitoring stations located at Weeks Island.

3.8 WEST HACKBERRY

3.8.1 Air Quality

West Hackberry operated in accordance with all air quality permit and regulatory requirements during 1984. No new air quality data was collected or developed during the past year. No construction or configurational changes which would have resulted in additional emissions were undertaken during 1984.

3.8.2 Surface Water Quality Monitoring

The West Hackberry surface waters were generally monitored on a weekly basis throughout 1984. To allow monthly data correlations ensuring temporal consistency, all weekly data were reduced to monthly averages. (The pH was reduced to monthly minimums and maximums.) All discussions of water quality data are based on these monthly averages. Specific monitoring stations are identified in Figure 3-7. Stations A, B, and C are located in Black Lake. (Station B is just offshore of a site drainage ditch leading from the high-pressure pump pad.) Station D is located in the southeast drainage ditch, and station E is at the discharge draining the high-pressure pump pad to Black Lake. A new station (F) was established at the raw water intake structure and sampled during 1984. Specific parameters monitored in the West Hackberry surface waters include pH, salinity, TDS, TSS, temperature, TOC, and oil and grease. Oil and grease was not monitored at station D. Monitoring of TOC was initiated in October, and samples were taken at station E only. This corresponds to the NPDES permit requirement recently imposed on the permitted site discharges.

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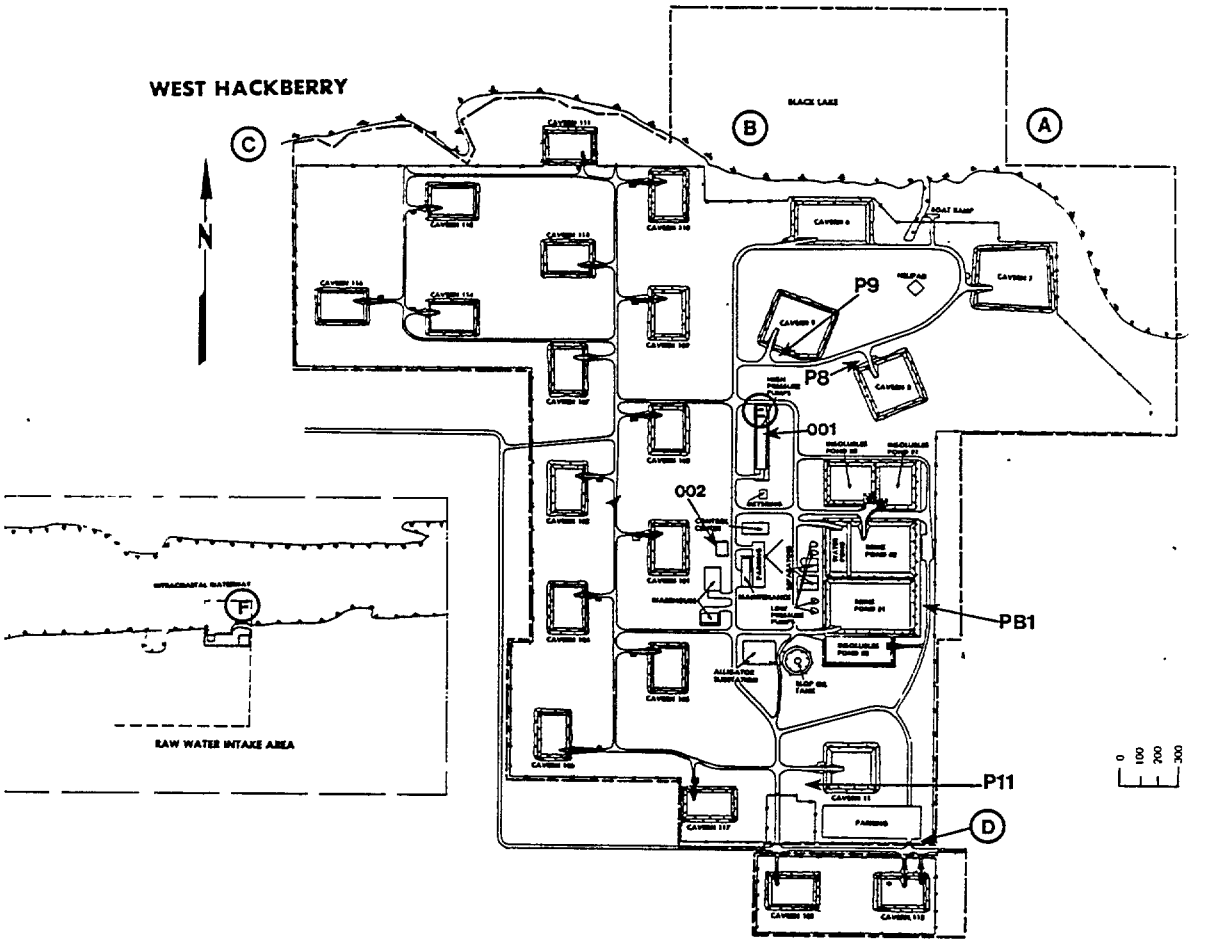

Figure 3-7 (Sheet 1 of 2). West Hackberry Environmental Monitoring Stations

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Discharge Monitoring Stations

001 Brine Disposal
002 Discharge from Sewage Treatment Plant
Stormwater Discharges
- Stormwater and Pump Flush from High-Pressure Pump Pad
- Stormwater Runoff from Well Pad 6
- Stormwater Runoff from Well Pad 7
- Stormwater Runoff from Well Pad 8
- Stormwater Runoff from Well Pad 9
- Stormwater Runoff from Well Pad 11
- Stormwater Runoff from Well Pad 101
- Stormwater Runoff from Well Pad 102
- Stormwater Runoff from Well Pad 103
- Stormwater Runoff from Well Pad 104
- Stormwater Runoff from Well Pad 105
- Stormwater Runoff from Well Pad 106
- Stormwater Runoff from Well Pad 107
- Stormwater Runoff from Well Pad 108
- Stormwater Runoff from Well Pad 109
- Stormwater Runoff from Well Pad 110
- Stormwater Runoff from Well Pad 111
- Stormwater Runoff from Well Pad 112
- Stormwater Runoff from Well Pad 113
- Stormwater Runoff from Well Pad 114
- Stormwater Runoff from Well Pad 115
- Stormwater Runoff from Well Pad 116

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

Figure 3-7 (Sheet 2 of 2). West Hackberry Environmental Monitoring Stations

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These parameters are discussed in turn, and the discussions are followed by summary observations.

3.8.2.1 Hydrogen Ion Activity (pH)

The pH ranged from a slightly acidic 6.7 to a somewhat basic 8.5. No stations exceeded the site water quality range criterion. The upper range of the monthly pH, on a station basis, exceeded 8.0 for 22 percent of the observations, which is similar to 1983 (23 percent) but less than the 45 percent recorded in 1982. Station F had lower overall pH than other stations but is the one station removed from the local West Hackberry waters. Natural waters devoid of carbon dioxide are medium hard to hard, with regard to mineral content, and characteristically slightly basic. Some compounds such as hydrogen cyanide and hydrogen sulfide increase in toxicity with the degree of dissociation, resulting in increasing compound toxicity to aquatic life with reduced pH. Considering this, a mildly basic pH is beneficial to aquatic life and consistent with an environmentally sound ecosystem.

3.8.2.2 Salinity

Salinity ranged from 0.7 to 20.0 ppt for stations A through F. Stations A, B, and C (Black Lake) ranged from 5.1 to 20.0 ppt with highest levels occurring in August and September. Although data is not complete for the year, this generally compares with a steady increase in salinity from May through November in 1982 but differs from 1983 in not having a mid-year decrease. Comparisons among stations demonstrated a highly positive correlation.

Wind, tide, and rainfall contributed to the salinity variation in Black Lake. Using the Venice system for marine water classification, Black Lake was generally classified as mesohaline (5 to 18 ppt) with only one excursion above 18 ppt (September).

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The salinity range limits Black Lake to euryhaline organisms or to those with sufficient motility to avoid salinity stresses.

Salinities at station D, the southeast drainage ditch, ranged from 0.9 ppt to 4.2 ppt. Monthly salinity values at station E, the high-pressure pump pad (HPP) runoff, ranged from 0.7 ppt to 8.4 ppt. The high salinity at this station was attributable to mechanical failure of a part of the brine system on the HPP. The HPP runoff is discharged into Black Lake near the vicinity of station B. Spill cleanup activity during this occurrence was excellent. A salinity of 8.4 ppt was recorded at station E; however, the salinity of the discharge entering Black Lake at station B was only 5.9 ppt. The salinities at stations A and C were 5.9 and 6.5 ppt respectively at this time, exhibiting no significant salinity difference.

3.8.2.3 Total Dissolved Solids

The TDS levels ranged from 1.3 to 38 times the site water criterion (500 mg/l) on a monthly and station basis. TDS sampled for only three months was compared to salinity at each station on a monthly basis by least squares regression analysis. This produced a very high correlation ($r=0.97$, $n=13$), demonstrating that statistically about 94 percent ($=r^2$) of the TDS variability can be attributed to salinity. In 1982, there was a correlation of $r=0.99$ and, in 1983, $r=0.93$ and thus a naturally induced tidal phenomenon. The slight change in correlation could be based on fewer samples in 1982 and 1984 and the variation in data collection frequency.

3.8.2.4 Total Suspended Solids

The TSS levels exceeded the site criterion 16 times (27 percent of the determinations) during the 1984 sampling year. The flowing water stations D and E had excessive suspended solids in only 9 percent of the determinations; the lake stations A, B,

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and C had excessive solids in 18 percent of the determinations; and station F had excessive solids in 90 percent of the determinations. Elevated levels of TSS occurred in the three lake stations 12 times from July throughout November. The TSS level at station E did not exceed the site criterion in 1984. This suggests that the high-pressure pump pad (station E) did not contribute to the higher levels of suspended solids in the lake. The high levels of solids from the raw water intake structure (station F) on the Gulf Intracoastal Waterway correspond with expected data based on channel size and vessel traffic. Comparison of TSS data between 1982, 1983, and 1984 shows similarities suggesting that occurrences of relatively high TSS were a result of natural phenomena, unrelated to site activities.

3.8.2.5 Temperature

Temperature was below the site maximum criterion of 32°C throughout 1984 at all sampling stations as it was in 1983. The temperature in Black Lake ranged from 13.8°C to 28°C. The highest temperatures for all stations were recorded in August, and the lowest temperatures were recorded in January and February. This correlates well with the last two year's data except that the coldest months fluctuated from November-December-January to December-January-February.

3.8.2.6 Oil and Grease

Oil and grease was observed at concentrations of less than 5 mg/l at all stations except on one occasion at lake station C and once at the high-pressure pump pad, station E. The elevated level of oil and grease at Station C in February (37.7 mg/l) was directly attributed to an oil spill in Black Lake from a non-SPR activity. The exceedance at station E in January (15.5 mg/l) resulted in a noncompliance. This was traced back to residual oily dirt washed into the oil water separator where the oil and grease remained adsorbed to the dirt particles.

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3.8.2.7 Total Organic Carbon

Total organic carbon became a required permit parameter in the renewed NPDES permit received in September. This parameter is applicable for all stormwater runoff from well pads and pump pads.

In order to monitor the potential effect the SPR could have on surface water quality, TOC sampling was initiated at station E. The data for October, November, and December were well below the 40 mg/l maximum criteria ranging from 19.2 mg/l to 25.5 mg/l.

3.8.2.8 General Observations

The following observations are made, based on the above discussion, concerning operational impacts on the West Hackberry aquatic environs.

a. Runoff from the high-pressure pump pad did not contribute to any significant increases in Black Lake's salinity at station B when compared with stations A and C. This continues a positive change from 1983 compared with 1982 and could be based on the change in the data base or, more likely, the continued emphasis on spill prevention and mitigation of brine leaks from the high pressure pump pad.

b. Although TDS levels were excessive at all stations relative to fresh water criteria, statistical analysis again demonstrated that ambient salinity was the primary cause of elevated TDS levels at West Hackberry.

c. TSS levels exceeded the site criterion in nearly one out of every four determinations. However, based on the uniform temporal-spatial distribution of TSS on site, the high TSS levels in Black Lake and the Gulf Intracoastal Waterway could not be attributed to specific site point source discharges.

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d. The single data point indicating an oil and grease level over 5.0 mg/l from the high-pressure pump pad was effectively mitigated as demonstrated by the lack of detection of elevated oil and grease levels attributable to the SPR in any of the Black Lake stations.

3.8.3 Water Discharge Permit Monitoring

The water discharges at the West Hackberry site are regulated and enforced in accordance with the Environmental Protection Agency's National Pollutant Discharge Elimination System. The Louisiana Stream Control Commission (LSCC) provided authorization to discharge rainwater and sanitary effluents in a 1979 letter to the Department of Energy. Brine discharge was reviewed in accordance with Act 423 of the Louisiana legislature.

The three catogories of discharges at West Hackberry are: brine discharge, package sewage treatment plant effluent, and stormwater runoff from well pads and pump pads. The various parameters analyzed from these discharges are listed below with their maximum limits.

Location/Discharge	Parameter	Maximum Value
brine discharge	flow	1.088 million barrels/ day; ±15% 25 f/s (thru Sept.) ≥ 25 f/s (under new permit)
	oil and grease	15 mg/l
	TSS	(report)
	TDS	(report)
	pH	≥ 6.0 - ≤ 9.0 units
sewage treatment plant	flow	(report)
	BOD_5	15 mg/l
	TSS	45 mg/l
	fecal coliform	(report)
	pH	≥ 6.0 - ≤ 9.0 units

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stormwater	flow	(report)
	oil and grease	15 mg/l
	TOC	75 mg/l
	pH	$\geq$ 6.0 - $\leq$ 9.0 units

Of 322 brine discharges to the Gulf of Mexico from the site, there were two noncompliances (see Table 3-8) and of the 468 stormwater discharges there were two noncompliances and one bypass. Nine noncompliances were associated with the 19 package sewage treatment plant discharges. The O&M contractor is currently investigating the chronic problems with the sewage treatment plant. It appears that there is a system overload created by additional onsite personnel causing intermittent surges and dramatic fluctuations in flow. At midday, the flows far exceed the plant's assimilative capacity while the lack of flow and organic load on weekends severely stresses the bacterial culture. A design to stabilize organic load and increase plant capacity is being prepared. Despite these inadequacies West Hackberry has maintained a 97.8 percent compliance level. When consideration is given to the total number of individual parameter analyses conducted for each discharge sample, permit compliance is well over 99 percent.

3.8.4 Active Permits

Active permits for West Hackberry are listed in Table 3-9. All permits were maintained in compliance in 1984 except for LA0053031. It should be noted that the individual excursions which exceeded the permit limits were either minimal or of very short duration. The surface water quality monitoring program demonstrated the insignificance of the noncompliances, as evidenced by lack of attributable adverse effects on the ecosystem.

3.8.5 Ground Water

The SPR Geological Site Characterization Report (SNL publication number SAND80-7131) and the Final Environmental Impact

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Outfall Location	Permit Parameter	Value / Limit	Cause
HPP	oil & grease (mg/l)	15.5 / 15.0	Excessive turbulence while washing down pad allowed adsorption of oil to silt particles. As material went through oil water separator, it did not separate.
WP108	oil & grease (mg/l)	21.9 / 15.0	During oil spill cleanup, oil was adsorbed to silt particles when washed off dikes and ditches. As fluid was discharged through oil water separator, it did not separate.
001	NO SAMPLE TAKEN ON WEEKEND		
001	pH (units)	5.8 / ≥ 6.0	Unknown. Samples prior and after noncompliance were within permit limitations.
WP113	BYPASS OF OIL WATER SEPARATOR TO CLEAN OUT DRAINS		
002	BOD_5 (mg/l)	18.5 / 15.0 (max)	The site sewage treatment plant has chronically suffered BOD_5 noncompliances. To correct this apparent problem, a subcontractor has been hired to identify and correct BOD levels presently attributed to the inability of the plant to handle high volumes and peak surges in excess of plant capacity. The site has experienced a two-fold increase in personnel.
002	BOD_5 (mg/l)	13.2 / 10.0 (avg)	
002	BOD_5 (mg/l)	22.2, 17.8, 20.0, 15.9 / 15.0 (max) 10.0 (avg)	
002	FECAL COLIFORM SAMPLE NOT TAKEN		
002	pH (units)	3.4 / ≥ 6.0	Subcontractor poured muriatic acid into floor drains which discharge into sewage treatment plant.

Table 3-8. 1984 Noncompliances/Bypasses at West Hackberry

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PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENT
LA0053031	EPA	Water	8/22/84	8/21/89	
LMNOD-SP (LTCS)26	COE	Dredging	2/8/79	2/7/89	(1)
LMNOD-SP (Black Lk)31	COE	Dredging	10/26/82	10/25/92	(1)
LMNOD-SP (Black Lk)43	COE	Dredging	7/26/84	7/25/87 8/1/94	(2) (1)
None	LOC	Injection	8/7/79	Open	(3)
971198,9	LDOC*	Injection	10/6/83	Open	(4)
None	LSCC	Water	3/30/79	Open	
1048	LACC	Air	10/26/78	Open	(5)

(1) Two-week prior written notification to District Engineer required.
(2) Notification to District Engineer required 2 days prior to start of construction.
(3) Approval to create 16 additional salt dome cavities.
(4) Approval to construct and operate wells 117A and B.
(5) Requires semi-annual status-of-construction report.

* LDOC - Louisiana Department of Conservation

Table 3-9. Active Permits at West Hackberry

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Statement, Texoma Group Salt Domes (publication number DOE/EIS-0029) were utilized as sources of ground water information for West Hackberry. There are three shallow aquifers found in the vicinity of the West Hackberry site. The Chicot aquifer, which lies closest to the surface in the Hackberry area, is mostly fresh water with salinity increasing as it gets closer to the coast. The Evangeline aquifer lies under the Chicot and the Jasper aquifer under the Evangeline aquifer.

The majority of the ground water pumping from the Chicot aquifer takes place in Lake Charles. The pumping is so great that the ground water gradient has been changed locally to flow from the south to the north. The fresh/saline water interface is approximately 700 feet from the surface.

On the West Hackberry site, there are four monitoring wells (PB1, P11, P8, and P9). The locations of these wells are:

a. PB1 - east side of the site next to the brine pond.
b. P8 - entrance to well pad 8.
c. P9 - entrance to well pad 9.
d. P11 - entrance to well pad 11. These locations are identified on the site map (Figure 3-7).

The monitoring wells have been sampled since 1982; however, there is no well log history or background information on their construction or installation. These wells are sampled at least once per month.

Monitoring well PB1 showed a slight decrease in ground water salinity during 1984. Salinity increased from 8.2 ppt in January to a high of 11.3 ppt in June falling to 6.9 ppt in December. Samples were not collected for the months of July and August. Salinity in monitoring wells P8 and P9 showed little change in 1984 while salinity in well P11 increased slightly.

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The ground water pH values observed from the monitoring wells P8, P9, and P11 were as expected ranging from 5.85 to 6.96. The low ground water pH was observed in monitoring well PB1 at 3.97 in December and a high of 6.54 in January.

3.8.6 Significant Environmental Activity

During 1984 the West Hackberry Environmental group undertook direct responsibility for inspection and maintenance of offshore brineline diffusers and associated marker buoys, negating the need and expense of previous arrangement of contract offshore support. The West Hackberry Environmental staff undertook a program of sampling and monitoring several apparently stressed oak trees located at the SPR property line in an effort to ascertain what impact, if any, the SPR may have on these trees. Two electrical transformers located at the site's raw water intake structure were found to contain dielectric fluid contaminated with 87 ppm and 12 ppm polychlorinated biphenyl (PCB). Decontamination of these transformers to 3 ppm and < 1 ppm PCB was accomplished in fulfillment of DOE mandated criteria (<5 ppm PCB within 100 feet of a waterway).

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4. QUALITY ASSURANCE

The SPR sites undergo periodic evaluation in the form of internal audits as well as audits by outside federal and state agencies throughout the year. During 1984 the Bryan Mound and West Hackberry laboratories participated in the fourth annual EPA Discharge Monitoring Report Quality Assurance Study. The SPR also continued conducting its own internal laboratory quality assurance study through analysis of blind samples on a semiannual basis. A structured ongoing laboratory quality assurance program has been implemented through the systematic application of acceptable accuracy and precision criteria. Compliance with this and other environmental program requirements was reviewed and evaluated at each site by means of annual audits.

4.1 EPA DISCHARGE MONITORING REPORT QUALITY ASSURANCE STUDY

The EPA entered the fourth year of its Discharge Monitoring Report Quality Assurance program. This program consists of providing the analytical laboratories of major NPDES dischargers with blind samples for analysis of permit parameters. After performance of the analyses, the permittee submits its data to EPA which evaluates the analytical accuracy relative to the performance of EPA referee laboratories. The Bryan Mound and West Hackberry laboratories each participated in this program during 1984 for the fourth time in as many years.

The analytical data submitted to EPA by the Bryan Mound and West Hackberry laboratories were found to be well within acceptance limits. Acceptability is defined as falling within $\pm$ 2.0 standard deviations of the statistically correct value. Those values falling within $\pm$ 1.5 to 2.0 standard deviations are acceptable with warning. The EPA results from Bryan Mound and West Hackberry expressed as variation in standard deviations are:

	Bryan Mound	West Hackberry
pH (std. units)	-0.26	+0.09
TSS (mg/l)	+0.31	+1.06

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Oil and Grease (mg/l)	+0.63	+0.19
TOC (mg/l)	-0.30	N/A
COD (mg/l)	-0.04	N/A
BOD_5 (mg/l)	N/A	-0.28

These data reflect the high quality of analysis performed by the Bryan Mound and West Hackberry laboratories in conjunction with permit monitoring and analysis.

4.2 SPR LABORATORY INTERNAL QUALITY ASSURANCE PROGRAM

The SPR conducts an internal Quality Assurance program modeled after the EPA program (paragraph 4.1) using EPA-supplied blind samples. This program, directed at the Bayou Choctaw (BC), Bryan Mound (BM), and West Hackberry (WH) laboratories, consists of semiannual analyses of blind samples supplied by the SPR project office. The analytical results of each laboratory are evaluated by the SPR project management office for acceptability under the same criteria as used by the EPA.

The results of the 1984 SPR Laboratory Quality Assurance program, performed during March and September, are as follows.

	March			September		
	BC	BM	WH	BC	BM	WH
pH (std. units)	-2.0	-0.2	0.0	+1.2	0.0	-0.8
Oil and Grease (mg/l)	-0.5	0.0	0.0	-1.4	-0.2	+0.2
TOC (mg/l)	+0.1	+0.5	N/A	+0.9	-0.1	+0.9
COD (mg l)	N/A	-0.8	N/A	N/A	-1.1	N/A
BOD_5(mg/l)	+0.7	N/A	-0.4	+1.0	N/A	-0.2
TDS (mg/l)	N/A	-0.3	-0.5	N/A	-0.9	+0.8
TSS (mg/l)	+0.4	+0.8	-0.8	+0.9	-0.2	-0.6
Conductivity (µmho)	+0.8	+1.0	+0.4	-1.2	+1.0	+0.6
Alkalinity (mg/l as $CaCO_3$)	N/A	+0.3	N/A	N/A	-0.4	N/A
Chloride (mg/l)	N/A	N/A	N/A	0.0	N/A	N/A

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All data fell within the ± 2.0 standard deviation acceptability criterion, and only one data point fell within the ± 1.5 to 2.0 standard deviation warning range.

The Bryan Mound laboratory performed quality assurance analyses on several additional parameters during September in support of their water quality monitoring program. The specific parameters evaluated, with standard deviations variation in parentheses, were iron (+0.8), potassium (-0.7), calcium (-1.2), magnesium (+0.2), and sulfate (-0.2). The low variation in standard deviations observed throughout 1984 at all SPR laboratories and for all parameters supports the implicit quality of analysis performed by the SPR laboratories.

4.3 SPR LABORATORY ACCURACY AND PRECISION PROGRAM

The SPR laboratory quality assurance program is based on the U.S. EPA Handbook for Analytical Quality Control in Water and Waste Water Laboratories (EPA-600/4-79-019). This program focuses on the use of analyses of field and laboratory spikes, standard recoveries, split samples, and blanks at regular intervals to determine the accuracy and precision of analyses. This EPA document advocates use of quality control charts to maintain and evaluate accuracy and precision data; however, this methodology is time consuming. The SPR has developed software for the Hewlett-Packard 41CX handheld computer to allow rapid and exact determinations of accuracy and precision without the necessity for preparation of quality control charts.

4.4 ENVIRONMENTAL DEPARTMENT AUDITS

The SPR project office conducts an annual environmental audit at each site. Each audit is conducted over a one- to two-day period followed by an outbriefing with site management and preparation of a formal audit report with specific recommendations as appropriate. Audit areas include environmental records, laboratory procedures and records, site housekeeping, operating procedures,

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training, environmental response equipment, and permit regulatory compliance. A general field inspection of the site environs is also conducted to assess the general site condition, changes attributable to site impacts, and the effects of planned and proposed site construction and modifications.

The 1984 environmental audits at each SPR site showed implementation and execution of the SPR Environmental Program to be outstanding. An especially noteworthy revelation during these audits was the high level of environmental awareness exhibited among all site personnel. SPR site management has placed a high priority on fulfilling the intent and conditions of the SPR Environmental Program.

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