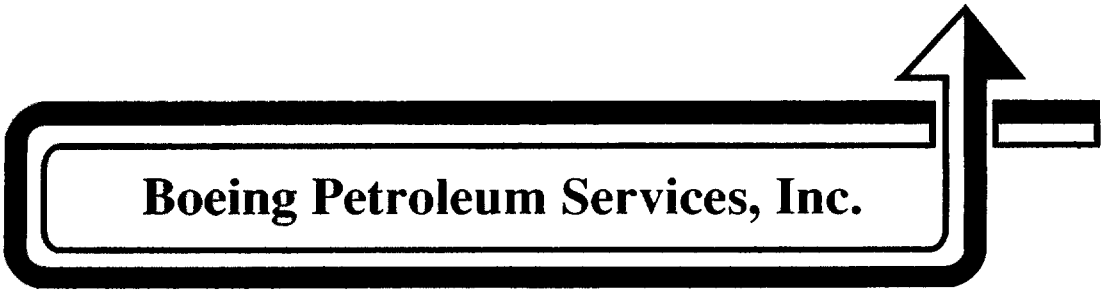
UNITED STATES DEPARTMENT OF ENERGY

STRATEGIC PETROLEUM RESERVE



1985 ANNUAL ENVIRONMENTAL MONITORIING REPORT FOR THE STRATEGIC PETROLEUM RESERVE

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BOEING PETROLEUM SERVICES, INC.
850 South Clearview Parkway
New Orleans, Louisiana 70123

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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), 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 an underground room-and-pillar salt mine. Additional space has been created by solution mining at four sites. The sixth and newest site is in the construction phase.

The sites were originally 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 Phillips 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. A new pipeline connecting the Bryan Mound site with the Texas City, Texas docks and area refineries is planned for construction in 1986.

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 site consists of a main and brine disposal area which occupy approximately 168 and 200 acres respectively. The area surrounding the site is rural, with a number of people living in small settlements along the nearby highways. The nearest communities are Addis to the northeast and Plaquemine to the southeast. Baton Rouge is the major source of housing and services for the site and is within easy commuting distance.

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 1954 resulted in the formation of a 12-acre lake (Cavern Lake) on the north side of the site.

Bottomland hardwood forest and deciduous swamps are predominant at the Bayou Choctaw site. The overstory vegetation at the site includes baldcypress, sweetgum, tupelo (characteristic of low-land areas), bulltongue, and spikerushes. Water oak is also present but not abundant. 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, ibis, 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, American alligator, and snakes.

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. Smaller canals and bayous, such as the North-South Canal and the East-West Canal, enter the site area and continue to Bull Bay and the Intracoastal Waterway.

1.2 BIG HILL

The Big Hill site 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 area around the site is used primarily for rice farming, cattle grazing, and oil and gas production. The permanent workforce is supplied in small part from the local area, with the remainder moving into the area or commuting from Beaumont or Port Arthur. During the current construction phase, much of the transient skilled labor is brought in from Houston, Galveston, or Lake Charles.

The site is situated on approximately 275 acres of land on the Big Hill salt dome 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. 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 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 are natural ridges (cheniers) paralleling the coastline, which at the present time isolate the marsh from the Gulf of Mexico.

Existing habitats in the vicinity of the site 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.

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 coyote, rabbits, raccoon, rodents, snakes, turtles, and numerous upland game birds and passerines. The adjacent grasslands which have been cultivated for 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, and includes several petrochemical related facilities. 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 form outside the immediate vicinity.

The site occupies approximately 500 acres 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 salt dome 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 Diversion Channel in a southern direction from Freeport until due west of the site. The levee then turns

east paralleling the north bank of the Intracoastal Waterway essentially bisecting the site.

The major water bodies near the site are Blue Lake to the north, and Mud Lake to the south. These water bodies generally define the mounded aspect of the Bryan Mound dome. 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 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 are typical of those found throughout this region of the Texas Gulf Coast. Brackish marshland dominates the low-lying portions of the site in all but the northern area, where the coastal prairie ecosystem extends along the levee 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 cordgrasses.

A diverse range of habitats is created by 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. The common egret, snowy egret, migratory waterfowl, great blue heron, least tern and black-necked stilt (the latter two being state-protected species), killdeer, nutria, raccoon, skunk, rattlesnakes, turtles, and frogs can be found on and in the area surrounding Bryan Mound.

Shrimp, crabs, trout, flounder, and redfish are abundant in Mud Lake 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, consists of 6 aboveground storage tanks and two tanker docks. The tank farm area occupies 105 acres and the dock 48 acres. The site is located on the west bank of the Mississippi River, approximately halfway between New Orleans and Baton Rouge, Louisiana, and approximately 1.9 miles north of the town of St. James, on Louisiana Highway 18. 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.

The terminal is surrounded by the Texas and Pacific Railroad to the west, commercial facilities to the north and south, and the Mississippi River levee on the east between Louisiana Highway 18 and the river. The area adjacent to the Mississippi River at the St. James docks is a freshwater wetland (batture). Much of the land area surrounding the terminal is used for pasture and sugar cane cultivation. Frogs, snakes, turtles, rabbits, 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 (approximately 175 acres) is located in Calcasieu Parish, 1.5 miles west of the town of Sulphur, Louisiana. There has been considerable industrial activity on and near the site 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.

The site is divided into the quadrangular primary site area and the figure-eight shaped secondary area. The secondary site area is bordered on the west, northwest, and north 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 mile east of the site. Changes in elevation throughout the site are minor, with most of the site 15 to 20 feet above sea level. The site proper is normally dry except in the spring season when high waters sometimes flood portions of it. The lowest elevations are over the center of the dome, where subsidence has occurred as a result of prior sulfur mining activity. Much of the surrounding area is covered with a mixed pine/hardwood forest.

Mammals on site and in the surrounding areas include 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 shallow ponds on the site.

1.6 WEEKS ISLAND

The Weeks Island site occupies approximately seven acres and is located in Iberia Parish, Louisiana, about 14 miles south of New Iberia. The surrounding area is sparsely populated. 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.

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 room-and-pillar mining, operated continuously until 1981, at which time operations were moved to another

part of the dome. The surface expression over the salt dome, caused by domal upthrusting, forms the "island" and includes the highest elevation (171 feet) in southern Louisiana. The area surrounding the island is a combination of swamp, marsh, bayous, manmade canals, and bays contiguous with the Gulf of Mexico.

The vegetation communities on Weeks Island are diverse. Lowland hardwood species proliferate in the very fertile loam soil base common at the higher elevations. The predominant tree species are oak, magnolia, and hickory, which extend down to the surrounding marsh. Pecan trees are also present. The coastal wetlands at the Weeks Island site include the manmade Intracoastal Waterway, saline and brackish marshes, and bayous. Gulls, terns, herons, and egrets are common in the marsh area. Mink, nutria, river otter, raccoon, and alligator are the most common inhabitants of the intermediate marshes. Others mammals found at 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 is the largest and least populous parish in Louisiana. 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 arivals to the area, and from the towns of Sulphur and Lake Charles in Calcasieu Parish.

The site is situated on 565 acres of land on top of the West Hackberry salt dome. The dome is covered by a distinct mounded

overburden on its western portion, with elevations up to 21 feet (the highest point in Cameron Parish). The rest of the dome is elevated about five feet above sea level.

Waterways in the site's vicinity 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. Black Lake, a brackish water lake, borders the "island" formed by the upthrusting 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 and then to the Intracoastal Waterway on the eastern side of the site. Black Lake Bayou continues wandering in a generally easterly direction from Black Lake, eventually connecting with the Calcasieu Ship Channel northeast of the town of Hackberry.

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, which affect 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, but rather a large region of small islands. Marshland closest to the coast generally has the highest salinity levels and lowest species diversity. Vegetation found on site and in the surrounding area of the West Hackberry facility is dominated by Chinese tallow, willow, various oak species, and numerous species of marsh and upland grasses. Red fox, American alligator, snakes, egrets, herons, roseate spoonbill, raccoon, nutria, opossum, rabbit, white-tailed deer, migratory waterfowl, and red-tailed hawk inhabit the area surrounding the West Hackberry site. 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

An environmental program was implemented by the previous operations and maintenance (O&M) contractor to the Department of Energy (DOE). Since April 1, 1985, a new contractor, responsible for management as well as operations and maintenance (MOM) of the SPR, is utilizing the same basic program. DOE, however, has the ultimate responsibility as owner and operator, in accordance with the understanding reached between the MOM contractor and DOE. The environmental program plan is thus designed to support the SPR through tasks 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 SPR Programmatic Environmental Action Report, Site Environmental Action Reports, and DOE Orders as a guide. The program includes monitoring permitted National Pollutant Discharge Elimination System (NPDES) outfalls and air emissions, making other required federal and state inspections, and 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 1985 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 environmental procedures and associated programs. Site management personnel have been briefed on the implementation of environmental procedures, spill reporting 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 applicable regulatory requirements.

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

2.3 REPORTING

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

2.3.1 Spill Reports

The Spill Reporting Procedures Manual (publication number 124-82-AS-001) identifies the procedure for reporting spills to the DOE and appropriate regulatory agencies. Specific reporting procedures are dependent upon several key factors including the quantity and type of material spilled, immediate and potential impacts of the spill and spill location (i.e., state, wetland, waterbody). Any spill considered significant at the site is first verbally reported to site management and then to the New Orleans MOM contractor management and the DOE representative. Verbal notification of the appropriate regulatory agencies

follows when necessary. Written reports from the site are usually submitted after cleanup, unless otherwise directed by the DOE or appropriate regulatory agency.

2.3.2 Discharge Monitoring Reports

Wastewater discharges from SPR sites are permitted by the Environmental Protection Agency (EPA) through the NPDES Program. Depending upon the permit requirements for the site, the required discharge sample analyses are reported to the state and EPA on either a monthly or quarterly basis. Included in the report is an explanation of the cause and actions taken to correct the noncompliance or bypass.

2.3.3 Other Reports

The MOM and O&M contractor provide several other reports to, or on behalf of, DOE as required. These reports include:

a. Fugitive air emissions for Bryan Mound (quarterly);
b. Emission Inventory Questionnaire update for St. James Terminal, Sulphur Mines and Weeks Island (annually);
c. Air Quality Construction Status Report for West Hackberry (semi-annually);
d. Permit Tracking System review and update;
e. Monthly Noncompliance and Spill Report with an annual summary for all sites;
f. Environmental Audit Reports for each site (annually);
g. Water Usage for Bryan Mound and Big Hill (annually);
h. Raw Water Usage and Brine Discharge Data for Bryan Mound and West Hackberry (monthly); and
i. Special study reports, as required.

2.4 OIL SPILLS RECAPITULATION

In 1985, the total amount of oil received was in excess of 42.8 million barrels. In addition, approximately 966,000 barrels were withdrawn and sold. During this period, 7 spills of one or more barrels occurred for a total of 537 barrels, which is

0.0013% of the total volume transported (amount received plus the amount sold). This represents a 46 and 63% reduction in the number of incidents and volume of oil spilled respectively as compared to 1984. The total number of spills has also dropped since 1982 and 1983. One spill accounted for approximately 275 barrels of the total volume spilled. This occasion was during drilling operations at Bayou Choctaw and involved piercement of a small indigenous oil pocket located within the caprock. Five spills were related to gasket leaks, equipment failure or design deficiencies. Two spills were associated with operator/maintenance error. All spilled oil was contained and recovered with no oil reaching a navigable waterway.

2.5 BRINE SPILLS RECAPITULATION

The SPR disposed 464 million barrels of brine (saturated sodium chloride solution) during 1985. Over 99% of the brine was disposed in the Gulf of Mexico via the Bryan Mound (43.5%) and West Hackberry (55.9%) brinelines. The remainder was disposed in saline aquifers via disposal wells at West Hackberry (0.1%), Bayou Choctaw (0.4%) and Sulphur Mines (0.1%) sites. Sixteen spill incidents of one or more barrels occurred (compared to 17 for 1984) for a total of 607,282 barrels, or 0.1% of the total volume of brine disposed. Of this amount, 99.8% of the brine was spilled during two incidents; one at Bryan Mound and the other at West Hackberry. No observed environmental impact resulted from either of these spills. Seventy-five percent of the spills were attributed to flange leaks or pipe failures.

2.6 NPDES COMPLIANCE

In 1985, a total of 7,142 analyses were performed to monitor wastewater discharge quality from the SPR in accordance with NPDES permits and corresponding state permits. Although 21 noncompliances were reported, the SPR was in compliance with permit requirements for approximately 99.7% of the analyses performed. Sixteen of the noncompliances related to sewage treatment plant

upsets, three resulted from failure to take samples, and two were associated with brineline operations.

2.7 OTHER PROGRAMS

During 1985, there were two major brine spills. In March, 30,000 barrels of brine spilled into Blue Lake at the Bryan Mound facility. An effective response by the site emergency response team mitigated the impact of this spill. Subsequent monitoring in Blue Lake (section 3.4.2.10) confirmed that the impact, if any, was short lived and minimal. The second spill happened in December when the brine pipeline to the Gulf of Mexico ruptured and up to 575,000 barrels of brine flowed into West Cove of Calcasieu Lake. Weather conditions, strong tidal currents, and lake morphology promoted rapid transport of the brine with attendant mixing into the adjacent ship channel. Subsequent monitoring of West Cove and the Calcasieu Ship Channel (section 3.8.2.8) showed no residual impact to the area.

The sewage treatment plant at West Hackberry was redesigned in accordance with operating data gathered over the past several years. Specialized modifications to the plant, intended to augment its capability to operate within permit limitations, were accomplished during 1985. Preliminary indications are that the plant will be capable of operating within permit limits.

The EPA raised concerns regarding trace levels of priority pollutants observed in soil samples at Bryan Mound. Analysis for EP toxicity was undertaken in an attempt to ascertain if a hazardous waste characteristic (toxicity) was exhibited and if priority pollutants could be expected to leach from the substrate. The results of these analyses were negative for EP toxicity. Trace amounts of a combined total of 26 priority pollutants were found in five samples.

In accordance with DOE Order 5480.14, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), an

installation assessment (Phase I) of all SPR sites was initiated during 1985. This assessment will be completed in early 1986. Recommendations regarding the need to proceed to Phase II of the program will be provided on a site-specific basis in the Phase I report.

3. ENVIRONMENTAL PROGRAM

3.1 INTRODUCTION

A primary goal of the MOM contractor is to ensure that all SPR activities are conducted in accordance with sound environmental practices. An effective 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 1985 air emissions were monitored through measurements and calculations from operating data. Volatile hydrocarbons arising from valves, pumps, tanks, tankers, and brine ponds are the predominant type of air emissions 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. Combustion (flaring) of displaced gases produced sulfur dioxide emissions during cavern fill at Weeks Island. Small amounts of hydrogen sulfide are associated with some crude oils handled and stored by the SPR. Dust emissions from most site roads have been mitigated through application of either pavement or dust control agents.

During 1985, 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.

3.1.1 Water Discharge Permit Monitoring

The water discharge permit monitoring program fulfills the requirements of the EPA NPDES, and analogous state programs. All SPR point source discharges are conducted in compliance with these federal and state programs.

All sites except Big Hill conducted point source discharges during 1985. These discharges are grouped as:

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

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

3.1.2 Environmental Permits

The active environmental permits required by regulatory agencies to construct and operate the SPR are listed by site. The discussion of site permits includes the number and type of non-compliances (if any) experienced at each 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 have monitoring wells which are periodically sampled. Various indicator parameters are monitored dependent upon the individual site, although sampling and monitoring of these wells are not required by any federal or state regulations or permits.

Background information is generally available on the construction and installation of the existing monitoring wells. The unique ground water characteristics of each individual site and monitoring analysis is discussed within each site section.

3.1.4 Radioactivity

A total of 124 nuclear density gauges, SGH Model No. 5190/5191 are located on pipelines within the Bayou Choctaw, West Hackberry, Sulphur Mines and Bryan Mound sites. The gauges are used for monitoring densities (oil and brine interface) in pipelines. Each gauge unit contains between 100 and 400 millicuries (mCi) of cesium 137. Wipe tests are performed every three years as recommended by the manufacturer. No radiation leakage has been detected to date. The MOM contractor is a general licensee under the manufacturer, Texas Nuclear (Texas License No. 6-1105).

Princeton Gamma Tech Model 100 Sulfur Analyzers are used in the Bryan Mound, West Hackberry, and Bayou Choctaw laboratories for analyzing sulfur concentrations in oil samples. The radioisotope within the analyzer contains 50 mCi of iron 55. No radiation leakage from the analyzer has been detected from semiannual wipe tests recommended by the manufacturer. The MOM contractor is a general licensee under Princeton Gamma Tech (NRC Licenses: 29-12783-02G and 29-12783-01).

3.2 BAYOU CHOCTAW

The Bayou Choctaw site will be used to store over 60 million barrels of crude oil. Currently, there are four solution-mined caverns with two additional caverns in development. Raw water is provided from Cavern Lake and brine is disposed via pipeline to 12 brine disposal wells located approximately two miles south of the site. There is a 36-inch crude oil pipeline connecting the site to the St. James Terminal.

3.2.1 Air Quality

During 1985 Bayou Choctaw operated in accordance with air-quality regulatory requirements. No new air quality data was collected or developed during the past year. There were no configurational changes which would have resulted in additional air emissions during 1985. 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 through September 1985. Water quality monitoring data was not gathered during October, November and December, 1985. Specific monitoring stations are identified in Figure 3-1. Parameters monitored in the Bayou Choctaw surface waters included pH, salinity, total suspended solids (TSS), temperature, dissolved oxygen (DO), five-day biochemical oxygen demand (BOD_5), and oil and grease. A discussion of each parameter follows.

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. The pH ranged from 6.8 to 8.6 falling below 7.0 in 14% of the samples analyzed. 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 environment in terms of reducing the toxicity of indigenous or contaminating compounds. Additionally, moderately hard natural waters generally have increased buffering capacity which protects against pH fluctuations.

The pH ranged from 7.1 to 8.8, 7.0 to 8.2, and 6.6 to 8.4 during 1982, 1983 and 1984 respectively. The 1982 through 1985 data have remained relatively constant in terms of median pH and range. The slight fluctuations observed are attributed to a variety of environmental and seasonal factors such as variations in rainfall or aquatic system flushing.

3.2.2.2 Salinity

Salinity at Station A was non-detectable throughout 1985. Station B was nonzero during February (1.0 ppt) and July through September (1.0 ppt to 9.0 ppt). Stations C and D were nonzero during May through September (except August when D was zero). Station B, located in the North-South Canal, receives effluent from the adjacent privately owned ethane storage facility. The elevated salinities observed in Station B are attributed to brining activities by the neighboring facility rather than the SPR.

Station C, located on the East-West Canal to the southeast of the brine pond, has historically shown a slightly elevated level of salinity (up to 5.0 ppt during 1985). This is partially attributed to station proximity to the brine pond, the waste-water treatment outfall, flood control system discharges, and residue from brining activities conducted by prior tenants of Bayou Choctaw. Station D salinities (up to 4 ppt), strongly influenced by Bull Bay and the Intracoastal Waterway, varied with Station C suggesting that ambient salinity fluctuations also contributed to the elevated salinities at Station C. Salinities at Stations B, C, and D generally reached higher concentrations during 1985 than during previous years. The higher concentrations are attributed to unusually dry weather in southern Louisiana during the summer of 1985 and the resultant decline in flushing activity.

3.2.2.3 Total Suspended Solids

Average annual TSS levels at Stations A, B, C, and D were 32.0 mg/l, 25.8 mg/l, 39.8 mg/l, and 36.9 mg/l respectively. The highest TSS level (81.4 mg/l) was observed during September at control station A which is located away from all SPR outfalls. Only SPR outfall 002 exceeded the permit limitation for TSS during 1985 with a discharge at 128 mg/l TSS during April. Station C, which monitors the outfall 002 receiving waters averaged 39.8 mg/l throughout 1985, suggesting this noncompliance had no discernible impact on the receiving waters.

3.2.2.4 Temperature

Temperatures ranged from 14°C at Station A during February to 27°C at stations C and D during June. Temperatures above 20°C were consistently observed at all stations, except during January and February. The temperature range varied by only 13°C during 1985; considerably less than the 20.5°C, 19.5°C and 20°C ranges observed during 1982, 1983, and 1984 respectively. This change is attributed to the generally moderate weather conditions of 1985. Bayou Choctaw produces no thermal discharges, thus temperature fluctuations are attributed to meteorological conditions.

3.2.2.5 Dissolved Oxygen

The DO ranged from 4.0 mg/l at Stations C and D during June and September to 8.7 mg/l at stations B and C during March and January. Levels were below 5.0 mg/l on only 6 occasions: at Station C from April through September (no observation in May), and at station D during September. All DO observations at Stations A and B during 1985 were in excess of 5.0 mg/l. The sewage treatment plant which discharges in the vicinity of station C, was in compliance for BOD_5 throughout the monitoring period. Thus, the depressed DO was more likely caused by the lack of flushing due to summer low flow conditions. No significant correlations between depressed DO and temperature or BOD_5

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_5 ranged from <1.5 mg/l to 7.2 mg/l. This value is typical for backwater swampland and consistent with the ranges observed during previous years (<1.0 mg/l to 5.9 mg/l). These data are indicative of low organic loading in the Bayou Choctaw surface waters supporting the contention that the observed depressed DO levels, discussed above, are not due to organic decomposition.

3.2.2.7 Oil and Grease

Oil and grease levels ranged between 11 and 12 mg/l at all four stations during January 1985. The elevated oil and grease concentrations are attributed to a spill or other industrial activity upstream of the SPR on Bayou Bourbeaux as indicated by the high oil and grease concentration at control station A and the other monitoring stations. No oil sheen on the water or impact to the ecosystem were observed. Oil and grease concentrations returned to nondetectable levels after January. Except for January, these data are consistent with that collected since 1982. These data favorably reflect the site spill prevention 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. The surrounding surface waters continue to be slightly basic, which is normal for the area.

b. The observed salinities were generally low. The intermittent slightly elevated salinities observed at station B, C, and D during the latter half of 1985 are apparently representative of ambient surface water conditions.

c. The consistently high TSS levels observed reflect ambient surface water conditions at Bayou Choctaw. Such conditions reduce the depth of the photic zone and tend to smother invertebrates, thus limiting variety at 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 a four-year period at both site and control stations.

d. Low levels of DO were observed predominantly at Station C and on one occasion at Station D. This phenomenon is attributed to low flow and minimal flushing typically observed at these stations during summer months.

e. The consistently low BOD_5 and nondetectable oil and grease levels observed during 1982, 1983, 1984, and 1985 (except during January 1985) 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 EPA (NPDES) permit and a corresponding permit issued by the Louisiana Department of Environmental Quality (LDEQ) Office of Water Resources. Discharges are from two package sewage treatment plants and stormwater runoff from well pads and pump pads (containment areas).

Parameters monitored for these discharge permits are described below.

Location/Discharge	Parameter	Maximum Value
sewage treatment plants	flow	(report)
	BOD_5	45 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

A total of 314 analyses were conducted on permitted outfalls to monitor NPDES compliance with four noncompliances (Table 3-2) during 1985. Individual parameters exceeded permit limitations on three occasions. Failure to sample on one occasion resulted in a lack of analyses for two additional parameters. The Bayou Choctaw compliance rate for 1985 was approximately 98%.

3.2.4 Active Permits

Table 3-3 lists the active permits at Bayou Choctaw. As part of the ongoing cavern engineering program, the Cavern Engineering Department obtains individual workover permits for each procedure that is undertaken at the site. These work authorizations, from the Louisiana Underground Injection Control Division, are limited to an individual operation per authorization. State inspectors regularly visit the site to observe drilling operations and document well certifications.

3.2.5 Ground Water

The Plaquemine Aquifer is the main source of fresh water for the site and several surrounding municipalities. It is located approximately 60 feet below the surface and extends to a depth of 500 to 600 feet. The upper 60 feet of sediments consist of Atchafalaya clay. The interface of freshwater and 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 near the brine pond. There are no well logs or other background information on these monitoring wells to facilitate data interpretation, thus no analyses of the groundwater were performed during 1985.

3.2.6 Other Significant Environmental Activity

New preventive maintenance schedules for the site sewage treatment plants were developed and included in the SPR integrated logistics system. Seven above ground fuel tanks (2,000 gallons to 12,000 gallons) were removed from the site eliminating potential spill sources and discharge monitoring associated with the tank containment areas. A program on Environmental Awareness was developed and included in the site training program. The crude oil pipeline was derated in regard to operating pressure, based on an instrumentation inspection of the line. The derated pressure was verified by hydrostatic testing. A mobile emergency command center was established and offsite spill response kits were assembled and provided to the site control center and pipeline crew.

3.3 BIG HILL

The Big Hill site is planned for the storage of 140 million barrels of crude oil in 14 caverns, as yet undeveloped. Raw water will be provided via 48-inch pipeline from the Intracoastal Waterway; brine will be disposed via 48-inch pipeline approximately five miles offshore in the Gulf of Mexico; and, crude oil will be transported between the site and the Sunoco Terminal in Nederland by a 36-inch pipeline.

3.3.1 Monitoring

Drilling and site construction started at the Big Hill site in 1983 and continued throughout 1984 and 1985. Construction of

several well pads neared completion during 1985. Construction of the site sewage treatment plant was initiated during the latter half of 1985. Construction of the site brine and raw water pipelines had not yet begun by the end of 1985.

The NPDES permit obtained from EPA and the discharge permit obtained from the Texas Water Commission (TWC) have provisions for a total of four outfalls. Brine discharge to the Gulf of Mexico (outfall 001) will be monitored for flow, oil and grease, TSS, total dissolved solids (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 in stormwater include flow, total organic carbon (TOC), pH, and oil and grease. The discharge point for the sewage treatment units (outfall 004) will go directly into the 10-acre onsite pond. This pond will discharge infrequently because evaporation 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 any 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 are listed in Table 3-4. There were no reportable discharges or noncompliances during 1985. The Federal Aviation Administration (FAA) notification for construction of the private-use only helipad is being renewed. Additional permits required for pipeline construction at highway and ditch crossings, as issued by the State of Texas or Jefferson County, are of such short duration that application will be made approximately three months prior to the specific pipeline crossing construction.

3.3.3 Ground Water

The three major subsurface hydrological units in the Big Hill area are the Chicot, Evangeline, and Burkville Aquifers. 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.

The town of Winnie uses fresh water from the upper Chicot Aquifer. Beaumont and Port Arthur withdraw their ground water from the lower Chicot Aquifer.

No ground water monitoring was conducted at Big Hill during 1985.

3.4 BRYAN MOUND

The Bryan Mound site is planned for a total capacity of 220 million barrels of crude oil in 20 solution-mined caverns. Appurtenant facilities include a 36-inch birne disposal pipeline extending 12.5 miles into the Gulf of Mexico; a raw water intake structure adjacent to the site on the Brazos River Diversion Channel and two 30-inch crude oil pipelines connecting the site to the Jones Creek Tank Farm three miles west of the site and the Phillips docks four miles northeast of the site.

3.4.1 Air Quality

Bryan Mound operated in accordance with all air quality regulatory requirements throughout 1985. The ongoing fugitive emissions monitoring program detected no leaks of hydrocarbon vapors from valves or pump seals. Based on historical data the TACB modified its Bryan Mound permit to reduce fugitive emissions monitoring to an annual requirement. The TACB also modified the Bryan Mound permit requirement for storage tank emission calculations so that a more applicable calculation methodology could be used. Hydrocarbon emissions from the surge tank average 3.3 tons per year during 1985, or 54% of the permit limit of 6.1 tons per year. The TACB inspection conducted at Bryan Mound during 1985 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 1985. Blue Lake was sampled monthly while Mud Lake was sampled only during April, May, and August due to wind and tidal induced flushing of the basin, which limited access.

Specific surface water 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. 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.

Specific parameters monitored in the Bryan Mound surface waters include pH, alkalinity, salinity, temperature, DO, TOC, chemical oxygen demand (COD), nitrite, nitrate, orthophosphate, soluble iron, calcium, and magnesium. The parameters are discussed in turn with some comparisons to 1982 through 1984 monitoring data. The discussions are followed by summary observations.

Eleven additional stations were established in Blue Lake during 1985 in response to the 30,000 barrel brine spill. These stations are identified as AA through JJ in Figure 3-4. These additional stations were monitored for salinity of the water column and the benthic interstitial water. The data from these stations are discussed separately in section 3.4.2.10.

3.4.2.1 Hydrogen Ion Activity (pH)

The hydrogen ion activity, or pH, was moderately basic, ranging from 8.1 in January to 9.8 in June and August in Blue Lake and 7.9 in August to 8.6 in May in Mud Lake. These consistently basic conditions are indicative of natural waters devoid of carbon dioxide and generally hard in regard to mineral content. Marine and estuarine waters, such as those in Blue Lake and Mud Lake are typically high in mineral content and basic in nature. The pH may fluctuate directly with the rate of carbon dioxide uptake as related to low primary productivity (low pH) in winter months and high primary productivity (higher pH) during summer months.

During 1982, 1983, and 1984 the pH measurements in Blue Lake and Mud Lake were observed to range from 7.7 to 10.1, 7.7 to 10.2, and 7.2 to 9.9 respectively, in general agreement with the 1985 data. Thus, pH fluctuations in the Bryan Mound surface waters appear to be the 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 water. The alkalinity in Blue Lake ranged from 52 mg/l in August to 152 mg/l as $CaCO_3$ in February, while the alkalinity in Mud Lake ranged from 132 mg/l in August to 148 mg/l as $CaCO_3$ in April. These levels of alkalinity, which provide some buffering capacity in the Bryan Mound waters, are in general agreement with data from previous years.

3.4.2.3 Salinity

The salinity in Blue Lake ranged from 3.0 to 5.0 ppt (oligohaline) throughout the year, with the exception of September during which a salinity of 7.0 ppt was observed. Salinity fluctuations were attributed to meteorologically induced conditions rather than site operations. The surface salinities were moderate throughout 1985 despite the large brine spill discussed in section 3.4.2.10.

The salinity in Mud Lake ranged from 10 ppt in April to 32 ppt in August. Using the Venice System for marine water classification, Mud Lake was classified as polyhaline (18 to 30 ppt) during all of 1985 with the exception of April when salinity in Mud Lake was mesohaline. The wider variation in Mud Lake salinity during 1985, as well as in previous years, is attributed to the strong tidal and wind influence on this lake and its rather direct communication with the Gulf of Mexico. 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°C in December to 30°C in June and July. The temperature in Mud Lake ranged from 27°C in August to 32°C in May. No measurements were taken during the winter months in Mud Lake limiting the comparisons which can be made with previous years. Temperature variation within each lake was generally limited to 1 or 2°C suggesting no site induced thermal effects.

Comparable temperatures were observed during previous years. Blue Lake ranged from lows of 17°C in December 1982, and 9°C in January 1983 and 1984 to highs of 33°C in August 1982, and 32°C in July 1983 and September 1984. Mud Lake ranged from lows of 16°C in December 1982, 15°C in February 1983, and 22°C in April 1984 to highs of 31°C in June 1982, 32°C in July 1983 and 29°C in July 1984.

3.4.2.5 Dissolved Oxygen

The DO concentration in Blue Lake ranged from 13.8 mg/l in October to 5.0 mg/l in September. The DO in Mud Lake ranged from 8.2 mg/l in April (no winter sampling) to 5.3 mg/l in August. These DO ranges are at generally acceptable levels for the support of aquatic organisms in naturally occurring warm bodies of water. Fluctuations in DO levels were attributed in part to the inverse relationship between temperature and DO (with these data n=84, r=0.5), as well as seasonal fluctuations in primary productivity, and meteorological factors such as wind driven mixing.

3.4.2.6 Total Organic Carbon

The TOC concentration in Blue Lake was relatively low, ranging from 4.7 mg/l to 8.7 mg/l throughout 1985 with the exception of January at station D where TOC was observed at 32.1 mg/l. Station D is the control station indicating that this relatively high TOC is not due to SPR activity, but rather some local and short lived event. The elevated levels of TOC observed during previous springs were not observed during 1985.

The TOC concentration in Mud Lake remained relatively low throughout 1985 ranging from 2.6 mg/l to 9.4 mg/l. This observed stability is consistent with observations of other parameters in Blue Lake suggesting that the relatively constant level of TOC throughout the year was characteristic of the 1985 season. The low levels of TOC observed in both bodies of water are consistent with a healthy ecosystem and 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 February, March, and April to 90 mg/l in June. These data are considerably lower (by a factor of 4) and more uniform than levels observed from 1982 to 1984. This phenomenon

is consistent with the low and stable TOC levels and relatively high and stable DO levels observed in Blue Lake throughout 1985.

The COD observed in Mud Lake ranged from 146 mg/l in May to non-detectable in August. This variation was considerably greater than was observed in Blue Lake. COD levels in Mud Lake were lower and more uniform between sampling intervals as compared to previous years. The higher variability relative to Blue Lake observations is again attributed to Mud 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 1985. These parameters provide an indication of eutrophication in natural waters.

Nitrate is a necessary nutrient to the metabolism of plants. The nitrate concentration in Blue Lake ranged from 1.0 mg/l during June to 7.5 mg/l in December. The nitrate concentration in Mud Lake ranged from 1.5 mg/l in August to 3.0 mg/l in April. 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 ranging from nondetectable concentrations (less than 0.01 mg/l) to 0.05 mg/l, with the exception of September when all stations were at 0.10 mg/l. These low levels of nitrite are consistent with expectations for natural waters.

Phosphate is a necessary nutrient to plant metabolism, functioning in biochemical energy transfer. Phosphate is generally found in small quantities in natural waters and is a common limiting factor to plant growth (primary production). Phosphate in Blue Lake was observed to range from a low of 0.5 mg/l in August to 8.0 mg/l during April. Mud Lake phosphate levels ranged from a low of 0.5 mg/l in April to a high of 1.0 mg/l in

May. Elevated levels of phosphate observed during 1983 and 1984 were attributed to resident and migratory waterfowl populations rafting in open water areas. However, during 1985 waterfowl moved from the open water sample stations and congregated in the marshy northwest corner of Blue Lake due to unusual hunting pressure. This change in habitat use apparently affected the level of observable phosphate. Stability of other parameters, such as DO, TOC, and COD, throughout 1985 is consistent with these phosphate observations.

3.4.2.9 Cations

Total soluble iron, calcium, and magnesium cations were monitored throughout 1985. Total soluble iron was observed at less than 1 mg/l in over 97% of the samples for Blue Lake. A maximum of 1.3 mg/l was observed in February. Mud Lake iron concentrations ranged between 1.5 mg/l and 8.3 mg/l. The low iron levels 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, 1983, and 1984 observations (average 2.6 mg/l, 1.7 mg/l and 4.3 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 73 mg/l (August) to 125 mg/l (December) in Blue Lake and 166 mg/l (April) to 368 mg/l (August) in Mud Lake. Magnesium ranged from 78 mg/l (May) to 183 mg/l (October) in Blue Lake and 300 mg/l (April) to 1,306 mg/l (June) in Mud Lake. These concentrations of calcium and magnesium in Blue Lake are similar with 1982, 1983, and 1984 observations. The concentrations of these micronutrients in Mud Lake increased by a factor of two to three during 1984 and 1985 over the 1982 and 1983 observations.

3.4.2.10 Additional Blue Lake Monitoring

Stations AA through JJ (Figure 3-4) were established in Blue Lake in response to the 30,000 barrel brine spill. The dense brine (specific gravity of 1.15) flowed from the spill area into Blue Lake (specific gravity of 1.003) as a fairly coherent mass settling in a pipeline trench crossing Blue Lake. The majority of the brine, which had diluted from 240 ppt to 100 ppt salinity, was removed from the lake by pumping from the low point of the pipeline trench. No dead organisms were observed in Blue Lake as a result of this spill. The pipeline trench was observed to be devoid of vegetation (using aerial photographs) prior to the spill occurrence. This suggests no observable impact to benthic flora.

Elevated salinities in the water column returned to ambient conditions with progression of the brine removal (approximately one week). Monthly analysis of the interstitial water in benthic samples indicated that elevated salinities (up to 35 ppt, or equivalent to Gulf of Mexico water) persisted at only the three stations located in the pipeline trench (BB, CC, and DD). These stations, located in the deepest portion of the affected area, returned to ambient conditions (5 ppt to 15 ppt) by June 1985. Interstitial monitoring continued throughout 1985.

3.4.2.11 General Observations

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

a. 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.

b. TOC, DO, and COD were observed to be constant and at moderate levels throughout 1985. This data, in combination with nonfluctuating macronutrient data for Blue Lake suggests that primary productivity was stable throughout the year.

c. The March brine spill into Blue Lake appears to have had no measurable impact on that ecosystem. Observed effects persisted in only the pipeline trench (until June) which is naturally devoid of vegetation. The maximum interstitial salinity observed immediately after the spill was consistent with seawater (35 ppt).

d. Mud Lake appeared to be of poorer 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 TWC's similar discharge permit program. The two categories of discharges are brine to the Gulf of Mexico and stormwater discharges from the tank farm, well pads, and pump pads. A site sewage plant installed toward the end of 1985 will become operable during 1986.

Parameters measured from the brine and stormwater discharges are described below.

Location/Discharge	Parameter	Maximum Value
brine discharge to Gulf	flow	1.1 million barrels/day (nozzle exit velocity $\geq$ 20 f/s)
	oil and grease	15 mg/l
	TDS	(report)
	TSS	(report)
storm water 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

A total of 3,428 analyses were performed on permitted outfalls for the purpose of monitoring NPDES and state discharge permit compliance during 1985. The brineline discharge to the Gulf of Mexico accounted for 796 of these analyses. Bryan Mound did not exceed any of the permit limitations for either the state or federal discharge permits during 1985 resulting in a 100% site compliance performance level.

The Bryan Mound site has a second TWC permit for the appropriation of state waters for the leaching program, site utility, and fire protection systems. The permit requires a yearly report of the quantity of water used. In 1985, the site appropriated 23,604 acre-feet of water from the Brazos River Diversion Channel. A total of 112,520 acre-feet of water has been appropriated to date for site activities which represents 52.3% of the total volume permitted.

3.4.4 Active Permits

Table 3-5 lists the active permits for the Bryan Mound site. Construction of a potable water line from a City of Freeport tie-in to the site was begun under permits from the COE, TDH&PT and Brazoria County. The project, including installation of a

sewage treatment plant (permitted by TWC #02271) was nearing completion at the end of 1985.

3.4.5 Ground Water

The Chicot and Evangeline Aquifers are the only two hydrological units that provide fresh or slightly saline water to the Bryan Mound area. The Brazoria County fresh water source is the upper unit of the Chicot Aquifer. Fresh water is conjectured by the literature to occur in the upper 80 feet of the aquifer over the salt dome with slightly saline water from -80 to approximately -225 feet. However, numerous wells drilled on site to supply drilling operations with fresh water are all brackish.

There are three monitoring wells (P1, P2, and P3) on the site. Locations of these wells are identified in Figure 3-3. The monitoring wells have been sampled since 1982, generally on a monthly basis. There are no well log histories or background information on the construction or installation of these wells.

During calendar year 1985, the pH of well P1 ranged from 6.03 to 6.47. Salinity ranged from 88 ppt in August to 112 ppt in May. COD ranged from 33 mg/l in February to 162 mg/l in June. P2 exhibited a low pH of 6.80 in September ranging to 7.21 in February. Salinity ranged from 5.0 ppt in November to 10.0 ppt in September. COD ranged from less than 25.0 mg/l in August to 124.5 mg/l in June. The pH for P3 ranged from 6.13 to 6.76. Salinity ranged from 21 ppt to 31 ppt and COD ranged from 11.2 mg/l to 197.0 mg/l.

The interconnection of the aquifers and the proximity to salt domes contributes to the salinity variation. Well installation and logging data is necessary to properly interpret the existing monitoring data. Monitoring of these wells will continue in order to establish a baseline for future study.

3.4.6 Other Significant Environmental Activity

Interstitial salinity analyses were performed (section 3.4.2.10) throughout 1985 in an effort to gather data on the flushing and exchange rate of interstitial waters. Analysis for EP toxicity was conducted on some weathered oil deposits and an old brine pond to determine if the substrate in these areas met hazardous waste criteria. Results from these analyses were negative. Two members of the site environmental staff and site operator were accredited as Class D sewage treatment plant operators in preparation for startup of the site sewage treatment plant.

3.5 ST. JAMES TERMINAL

The St. James Terminal consists of six above-ground storage tanks (total capacity two million barrels), two tanker docks, and appurtenant site facilities. St. James is connected to Weeks Island and Bayou Choctaw by a 36-inch crude oil pipeline.

3.5.1 Air Quality

St. James Terminal operated in accordance with all air quality permit and regulatory requirements during 1985. St. James is located in a nonattainment area for ozone. Oil movements were limited to intersite pipeline pigging operations and a single ship loading conducted as part of a test sale of SPR crude oil. 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.

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 3-5) into the Mississippi River. Two wastewater treatment plants, which serve the site control and maintenance buildings, discharge as state outfalls 002 and 003 through outfall 001 into the Mississippi River.

At St. James, the Mississippi River has a large flow volume, and rapid currents, which provide a strong assimilative capacity. The intermittent nature of discharges from site outfalls, the characteristic hydrographic features of the Mississippi River at that point, and an on-going 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 LDEQ has also issued a water discharge permit for the site which includes outfall 001 with 002 and 003. The latter two are outfalls from the two site package sewage treatment plants. All individual discharges are through a common pipe to the Mississippi River.

Parameters measured from the outfalls are described below.

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 required analyses made on the site discharges were within permit limitations resulting in a 100% compliance level for 1985.

3.5.4 Active Permits

Table 3-6 lists the active permits at St. James Terminal. A total of 74 analyses were performed on permitted outfalls to monitor NPDES and state discharge permit compliance during 1985.

3.5.5 Ground Water

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

Construction of the St. James crude oil laboratory was initiated during 1985. An Environmental Awareness training program was developed and provided to the site for ongoing training. A crude oil tanker was loaded without environmental incident at the St. James Dock as part of the SPR crude oil test sale. An external floating roof tank seal inspection program was initiated in accordance with state air quality regulations. A tank roof seal replacement schedule was developed for all six tanks.

3.6 SULPHUR MINES

Sulphur Mines stores 26 million barrels of crude oil in five existing solution-mined caverns. The site is connected to the Sunoco Terminal in Nederland by way of a 16-inch crude oil pipeline which connects to the West Hackberry 42-inch line at the Gulf Intracoastal Waterway. Brine disposal is via injection into four brine disposal wells located approximately two miles southwest of the site.

3.6.1 Air Quality

Sulphur Mines operated in accordance with all air quality permit and regulatory requirements during 1985. This SPR site is located in a nonattainment area for ozone. No configurational or operational changes affecting emission rates occurred at Sulphur Mines. No air quality monitoring was conducted during 1985.

3.6.2 Surface Water Quality Monitoring

Water quality monitoring at the Sulphur Mines site was conducted on a weekly to monthly basis throughout 1985. For comparison purposes, the weekly data were averaged by month (except pH which was reduced to monthly minimums and maximums). Specific monitoring stations are identified in Figure 3-6. Station C was monitored only during October. Specific parameters monitored in the Sulphur Mines surface waters include pH, salinity, TSS, temperature, oil and grease, and DO. These data are discussed by temporal and spatial relationships, including comparisons with 1982, 1983, and 1984 data, followed by summary observations.

3.6.2.1 Hydrogen Ion Activity (pH)

The median pH was 7.2 ranging from a low of 5.6 at station A in August to a high of 8.7 at station G in February. This data is higher (less acidic) than the median pHs observed during 1982 (6.0), 1983 (6.1), and 1984 (6.4). The minimum and maximum pHs occurred during June and March, respectively during 1982, 1983, and 1984. The pH tended to be slightly acidic at station A with a median pH of 6.5. Stations B, D, E, F, and G were neutral to slightly basic with respective median pHs of 7.2, 7.5, 7.4, 7.5, and 8.0. The only significantly low pH (5.6) was observed during 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 slightly 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 1985 and was not considered a factor in the observed low pHs. Geochemical processes, stemming at least in part from past sulfur mining activity, are considered the most likely cause of the generally acidic conditions observed at Sulphur Mines.

3.6.2.2 Salinity

The salinity of the surface waters at Sulphur Mines was oligohaline (0.5 to 5 ppt), with the exception of station F (average salinity of 0.8 ppt), which was limnetic (less than 0.5 ppt) throughout 1985.

The salinity levels at station F were consistent with data from previous years. These waters are part of the local flood control canal system and are separate and distinct from the local Sulphur Mines surface drainage. The relatively high salinity observed at Station G, the subsidence area, was also consistent with previous observations and is attributed to the Frasch sulfur mining activity that occurred from 1896 to 1924 and again in the late 1960's.

3.6.2.3 Total Suspended Solids

The monthly TSS levels ranged from 2.3 mg/l to 51.0 mg/l during 1985. This distribution is consistent with 1984 observations when nearly a quarter of the data also exceeded a 15.0 mg/l benchmark by approximately 12 mg/l. All site point source discharges were within permit limitations for TSS throughout 1985. The generally high and variable TSS levels observed at Sulphur Mines are not attributed to site discharges into surface waters.

3.6.2.4 Temperature

The observed temperatures of the Sulphur Mines surface waters were generally acceptable for aquatic life in warm waters throughout 1985. The maximum station temperatures (averaging 29°C) were observed during June, July, and August, while the minimum temperatures (averaging 14°C) were observed during December, January, and February. This moderate temperature distribution, which approximates the 1982, 1983, and 1984 observations, is slightly warmer than temperatures previously observed.

3.6.2.5 Oil and Grease

No detectable levels of oil and grease (less than 5 mg/l) were observed during 1985 at any of the monitoring stations.

3.6.2.6 Dissolved Oxygen

Station A is located in a relatively stagnant drainage ditch that receives effluent from the site package sewage treatment plant. The DO at this location ranged from 1.8 mg/l to 9.1 mg/l with lowest levels observed during May (4.7 mg/l), September (3.3 mg/l), and November (1.8 mg/l). Six noncompliances for BOD_5 in the sewage treatment plant effluent occurred during the year with two noncompliances coinciding with the low DO levels (May and September). Although this influent organic loading (183 mg/l and 77 mg/l) may have contributed to the depressed DO, natural organic loading and algae population are likely to have been contributory. This speculation is supported by a moderate DO observed during August when temperatures were high and a noncompliance (BOD_5 value of 232 mg/l) was experienced.

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 1985 suggests that the slightly acidic water quality conditions at Sulphur Mines are attributable to geochemical and meteorological conditions.

b. The small increase in water temperature observed during 1985 relative to 1984 is attributed to meteorological variation since the SPR conducts no thermal discharges.

c. High BOD_5 from the site sewage treatment plant may have contributed to natural factors likely responsible for the low DO levels.

3.6.3 Water Discharge Permit Monitoring

The six water discharge points at Sulphur Mines are regulated and enforced through the EPA 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 described below.

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 359 analyses were conducted on permitted outfalls to monitor NPDES compliance during 1985. Individual parameters exceeded the permit limitations on six occasions (Table 3-7) and lack of a sample resulted in the seventh noncompliance. The site maintained a compliance performance level of 98%.

3.6.4 Active Permits

Table 3-8 lists the active permits at Sulphur Mines. The salt-water disposal wells are routinely exercised, and all state underground injection control certifications are current. The required one-time work authorizations for the individual wells were obtained by the Cavern Engineering Department. State inspectors regularly visit the site to observe underground injection operations.

3.6.5 Ground Water

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 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 ground water monitoring wells on the Sulphur Mines site.

3.6.6 Other Significant Environmental Activity

Water accumulating in the brine pond underdrain system was monitored and analyzed. The pH was relatively constant (range 6.0 to 6.5). Salinity rose steadily from 39 ppt during February to 210 ppt during November. Monitoring will continue in 1986.

3.7 WEEKS ISLAND

The Weeks Island site consists of a large conventionally-mined salt mine with a 73-million barrel crude oil storage capacity. In addition to normal site facilities, there is a 68-mile long 36-inch crude oil pipeline connecting the site to the St. James Terminal.

3.7.1 Air Quality

Weeks Island operated in accordance with all air quality permit and regulatory requirements during 1985. No configurational or operational changes affecting emission rates occurred at Weeks Island. No air quality monitoring was conducted during 1985.

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 directly into these lakes. Other surface waters at this site are intermittent in nature, draining rapidly and thoroughly after any precipitation. The site outfalls 01A, 01B, and 002 (Figure 3-7) discharge small volumes into surface drainage at a substantial distance from receiving waters. 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 01B and 002) consist of effluent from the package sewage treatment plants. Outfall 01A consists of 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
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

A total of 117 analyses were conducted on permitted outfalls to monitor NPDES compliance during 1985. There were seven non-compliances in 1985, six from the two site sewage treatment plants and one from the stormwater outfall (Table 3-9). The noncompliances, on an individual parameter basis, resulted in a site compliance performance level of 94%.

3.7.4 Active Permits

The active permits for Weeks Island are indicated in Table 3-10. All applicable permits for activities at the facility have been maintained.

3.7.5 Ground Water

The Chicot formation is the principal aquifer in the Weeks Island area. The aquifer surface is at approximately sea level near Weeks Island and slopes slightly northwest towards a cone of depression attributed to heavy withdrawals in the Lake Charles area. Some of the upper sand layers in the Chicot Aquifer contain fresh water becoming saline at approximately 300 to 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.

3.7.6 Other Significant Environmental Activity

During 1985 an Environmental Awareness training program was developed and provided to the site for ongoing training. The Weeks Island mine was sampled for representative crude oil components. Offsite spill response kits were assembled and provided to the control center for use in the event of an offsite spill.

3.8 WEST HACKBERRY

The West Hackberry site is planned for storage of 220 million barrels of crude oil in 22 solution-mined caverns. Brine disposal is by a 36-inch pipeline extending approximately eight miles into the Gulf of Mexico or by injection into eight active brine disposal wells located approximately two miles southeast of the site. Raw water is brought to the site via pipeline from the Intracoastal Waterway and crude oil is transported between the site and the Sunoco Terminal in Nederland via a 42-inch crude oil pipeline.

3.8.1 Air Quality

West Hackberry operated in accordance with all air quality permit and regulatory requirements during 1985. 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 1985.

3.8.2 Surface Water Quality Monitoring

The West Hackberry surface waters were generally monitored on a monthly basis throughout 1985. Specific monitoring stations are indicated and identified in Figure 3-8. Specific parameters monitored in the West Hackberry surface waters include pH, salinity, TSS, temperature, TOC, and oil and grease. Oil and grease was not monitored at station D. The TOC was monitored at only Station E corresponding to the NPDES permit requirement regarding site discharges. These parameters are discussed in turn, and the discussions are followed by summary observations.

Additional water column and benthic interstitial water analyses were undertaken in West Cove (Figure 3-9) adjacent to Calcasieu Lake in response to an estimated 575,000 barrel brine spill. These analyses were performed to determine in situ salinities as a measure of impact from the spill event.

3.8.2.1 Hydrogen Ion Activity (pH)

The pH ranged from a slightly acidic 6.4 to a somewhat basic 8.5. The upper range of the monthly pH, on a station basis, exceeded 8.0 for 20% of the observations, which is similar to 1984 (22%) and 1983 (23%) observations but less than the 45% recorded in 1982. The pH dipped below 7.0 during February and March at station F located on the Intracoastal Waterway. Natural waters low in or 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 aquatic toxicity with reduced pH. In this regard, a mildly basic pH is beneficial to aquatic life and consistent with an environmentally sound ecosystem.

3.8.2.2 Salinity

Salinity ranged from 0.1 to 16.5 ppt for stations A through F. Stations A, B, and C (Black Lake) ranged from 3.5 to 16.5 ppt with highest levels occurring in June through October. This Black Lake data compares well with a steady increase in salinity observed from May through November in 1982 and 1984 (incomplete data year) but differs from 1983 data in not having a mid-year decline. Comparisons among stations demonstrated a highly positive correlation.

Wind, tide, and rainfall contributed to the salinity variation in Black Lake. Black Lake was classified as mesohaline (5 to 18 ppt) 73% of the time and oligohaline the remainder of the time (March, April, and December). The broad salinity range limits Black Lake

to euryhaline organisms and those with sufficient motility to avoid salinity stresses with such seasonal changes.

Salinities at station D, the southeast drainage ditch, ranged from 0.8 ppt to 8.0 ppt. Monthly salinity values at station E, the HPP pad runoff, ranged from 0.8 ppt to 2.1 ppt. Station E is less saline than Black Lake and fluctuates independently of Black Lake stations suggesting there is no measurable impact from this SPR runoff.

3.8.2.3 Total Suspended Solids

TSS ranged from 0.5 mg/l to 152.5 mg/l with the lowest range occurring in Black Lake (1.0 mg/l to 45.5 mg/l). Similar ranges were found at Station E (0.5 mg/l to 59.2 mg/l) and Station F (1.3 mg/l to 61.2 mg/l). The highest range was found at Station D (3.0 mg/l to 152.5 mg/l). The maximum TSS (152.5 mg/l) observed at Station D is apparently anomalous in nature with the second highest TSS value being only 36.0 mg/l.

Elevated levels of TSS occurred in the three lake stations during February, March, April, June, September, and October. This phenomenon is attributed to wind and wave driven mixing in the shallow lake. The TSS level at station E was elevated during March when all three lake stations were high. This suggests that the HPP pad station E did not significantly contribute to the higher levels of suspended solids in the lake. The consistently high level of solids at station F (raw water intake structures on the ILW) corresponds to expected data based on channel size and vessel traffic. Comparison of 1985 TSS data to previous year's data shows similarities suggesting that occurrence of relatively high TSS levels are typical for these water bodies.

3.8.2.4 Temperature

The temperature in Black Lake ranged from 14.2°C to 27.0°C. The highest temperatures were recorded from March through October with a slight decline during August, attributable to two hurricanes during that month. The temperature ranges were slightly less than previous years, but were indicative of regional climatic effects (consistent with observations at other sites).

3.8.2.5 Oil and Grease

Oil and grease was observed at concentrations of less than 5 mg/l (non-detectable levels) at all stations except E on one occasion. This elevated oil and grease level occurred during March (33.8 mg/l) and was directly attributed to a noncompliance from the HPP pad due to heavy rains flooding the oil/water separator and flushing out contained lubricating oil. No oil and grease was detected at Black Lake Station B located just off the drainage ditch from the HPP pad.

3.8.2.6 Total Organic Carbon

TOC is an NPDES permit required parameter for discharges from the HPP pads as well as other stormwater discharges. TOC ranged from 9.5 mg/l during August to 27.7 mg/l during March. These levels of TOC are generally acceptable for an area dominated by industrial runoff. The fluctuation in TOC is likely related to activity on the pump pad and growth of algae in the ditch.

3.8.2.7 Additional Monitoring in West Cove

Nineteen stations (Figure 3-9) were monitored (during December 1985) in West Cove, the Calcasieu Ship Channel (adjacent to West Cove), and Hog Island Gully (a nearby canal). This monitoring was conducted in response to an estimated 575,000 barrel spill from the West Hackberry brineline. Salinity and temperature profiles were developed for the entire water column at each station in an effort to identify any bottom pooling of brine and any residual impacts. Benthic core samples from select stations

were also taken in an effort to identify impacts to that environment.

All observed salinities (8 ppt to 13 ppt) were consistent with control stations and normal for the indigenous organisms such as oysters. Interstitial salinities were consistent with ambient water column data suggesting no lasting impact. A slight halocline (3 ppt) observed in the Calcasieu Ship Channel was accompanied by an inverted thermocline suggesting it was a tongue of the saltwater wedge from the Gulf of Mexico.

The spilled brine appeared to have been rapidly mixed and pushed into the Calcasieu Ship Channel by strong tides and winds associated with a passing cold front during the leak. Further mixing in the ship channel was likely driven by propeller wash from passing ship traffic. The depth of the ship channel (40+ feet) relative to West Cove and Calcasieu Lake (5 feet) makes it unlikely high density brine would have traveled anywhere but down the ship channel to be dispersed and mixed with Calcasieu Ship Channel water enroute to the Gulf of Mexico.

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 HPP pad was of lower salinity than the Black Lake receiving waters. This demonstrates continuing good control of brine leaks and spills as has been observed since 1982.

b. TSS levels fluctuated widely at all stations during 1985 indicating that such fluctuation is indigenous to the area. High levels of TSS in Black Lake did not appear to be related to site discharges or runoff.

c. The single data point indicating an oil and grease level over 5.0 mg/l from the high-pressure pump pad was effectively mitigated. Elevated oil and grease levels were not observed in any 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 EPA NPDES permit program. The Louisiana Stream Control Commission (LSCC) (currently in LDEQ) authorized discharge of rainwater and sanitary wastewater effluents.

The three categories of discharges at West Hackberry are brine to the Gulf, 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 (nozzle exit velocity $\geq$ 25 f/s)
	oil and grease	15 mg/l
	TSS	(report)
	TDS	(report)
	pH	$\geq$ 6.0 - $\leq$ 9.0 units
sewage treatment plant	flow	(report)
	BOD_5	15 mg/l
	TSS	45 mg/l
	fecal coliform	(report)
	pH	$\geq$ 6.0 - $\leq$ 9.0 units
stormwater	flow	(report)
	oil and grease	15 mg/l
	TOC	75 mg/l
	pH	$\geq$ 6.0 - $\leq$ 9.0 units

A total of 2,850 analyses were conducted on permitted outfalls to monitor NPDES compliance during 1985. The brineline discharge to the Gulf of Mexico accounted for 1,328 analyses.

Noncompliances with permit brineline requirements were identified on three occasions (Table 3-11). These noncompliances were minimal and of very short duration. There was no indication that any noncompliance adversely affected the surrounding environment based on data from the surface water monitoring program. These 1985 noncompliances, on a per analysis basis, resulted in a site compliance performance level in excess of 99%.

3.8.4 Active Permits

Active permits for West Hackberry are listed in Table 3-12. All permits were maintained during the year.

3.8.5 Ground Water

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 with proximity to the coast. The Evangeline Aquifer lies under the Chicot and the Jasper Aquifer.

The majority of the ground water pumping from the Chicot Aquifer takes place in the Lake Charles area. The pumping is so great that the ground water gradient has been reversed locally, flowing from the south to the north. The fresh/saline water interface is approximately 700 feet below the surface.

On the West Hackberry site, there are four monitoring wells (Figure 3-8). These monitoring wells have been sampled monthly since 1982. Well log histories and background information on construction and installation are lacking for most wells.

Monitoring well PB1 showed a slight increase in ground water salinity during 1985. Salinity increased from 7.8 ppt in January to a high of 17.0 ppt in September falling to 13.0 ppt in December. Samples were not collected for May. Salinity in monitoring wells P8, P9, and P11 showed only slight fluctuations

during 1985. The ground water pH values observed from the monitoring wells P8, P9, and P11 were as expected ranging from 5.8 to 7.1. The pH in ground water monitoring well PB1 ranged from 4.2 during January to 4.7 during September.

3.8.6 Other Significant Environmental Activity

Sampling and monitoring of several apparently stressed oak trees located near the property line continued in an effort to assess their general health. Several environmental assessment surveys were performed in the West Cove area as a result of the brine pipeline spill (Section 3.8.2.7). The West Hackberry sewage treatment plant was redesigned and modified to meet operating and permit requirements.

3.9 CONCLUSION

No adverse environmental impact resulting from SPR activities was observed during 1985. The SPR continues to maintain an excellent environmental record.

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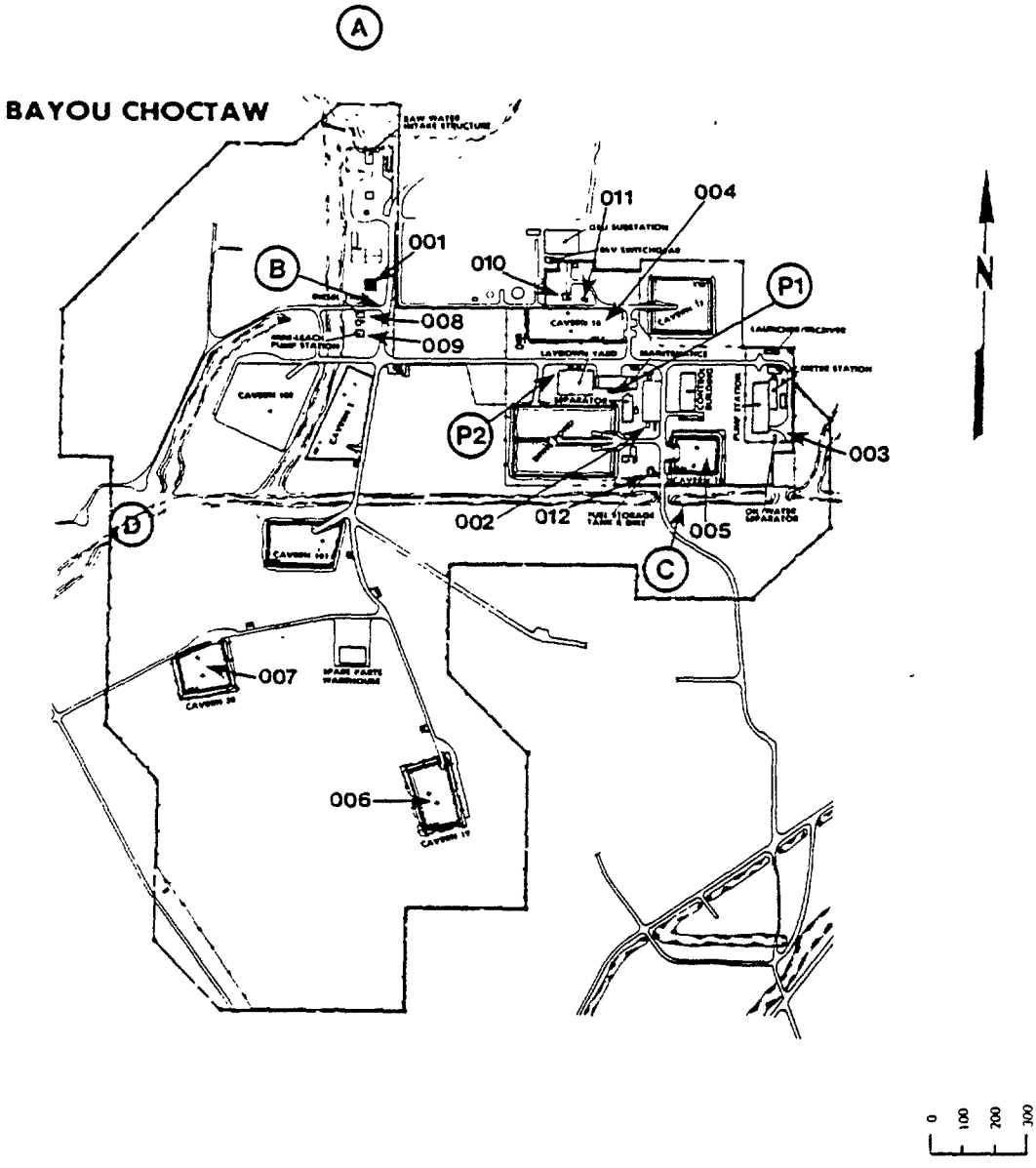

Figure 3-1 (Sheet 1 of 2). Bayou Choctaw Environmental Monitoring Stations

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 Cavern 10

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

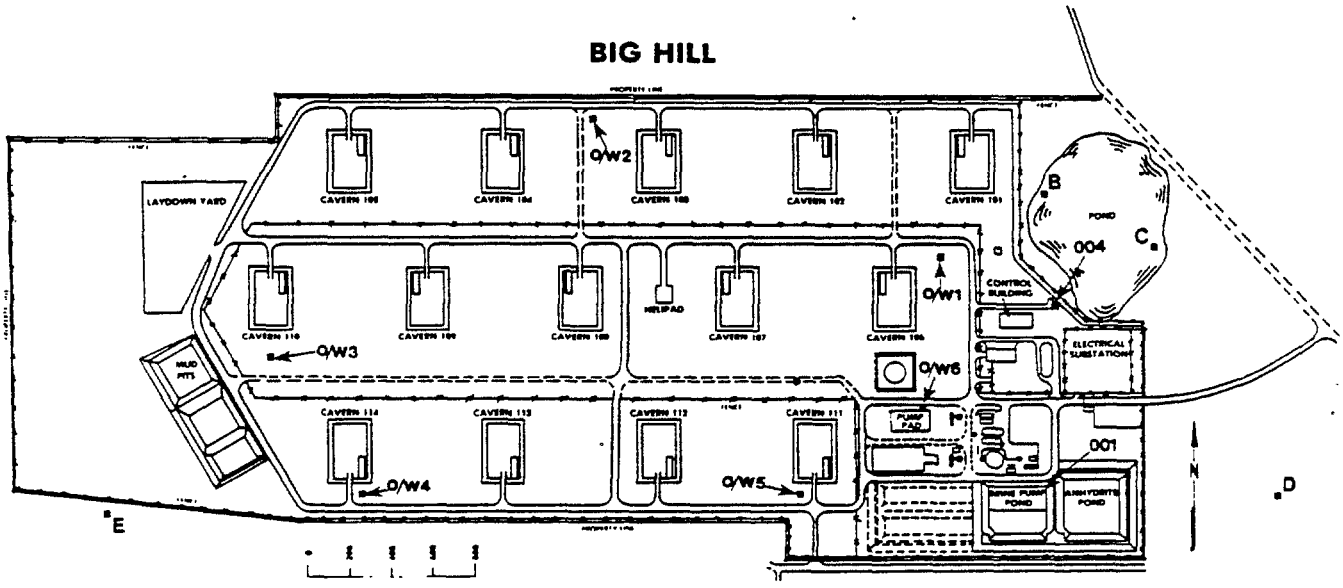

Figure 3-2 (Sheet 1 of 2). Big Hill Environmental Monitoring Stations

Planned Discharge Monitoring Stations

001 Brine Disposal

002 Hydroclone and Blowdown at Raw Water Intake Structure

003 Stormwater Discharges

- 0/W1 Stormwater from Well Pads 101, 102, 106
- 0/W2 Stormwater from Well Pads 103, 107, 108
- 0/W3 Stormwater from Well Pads 104, 105, 109, 110
- 0/W4 Stormwater from Well Pads 113, 114
- 0/W5 Stormwater from Well Pads 111, 112
- 0/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

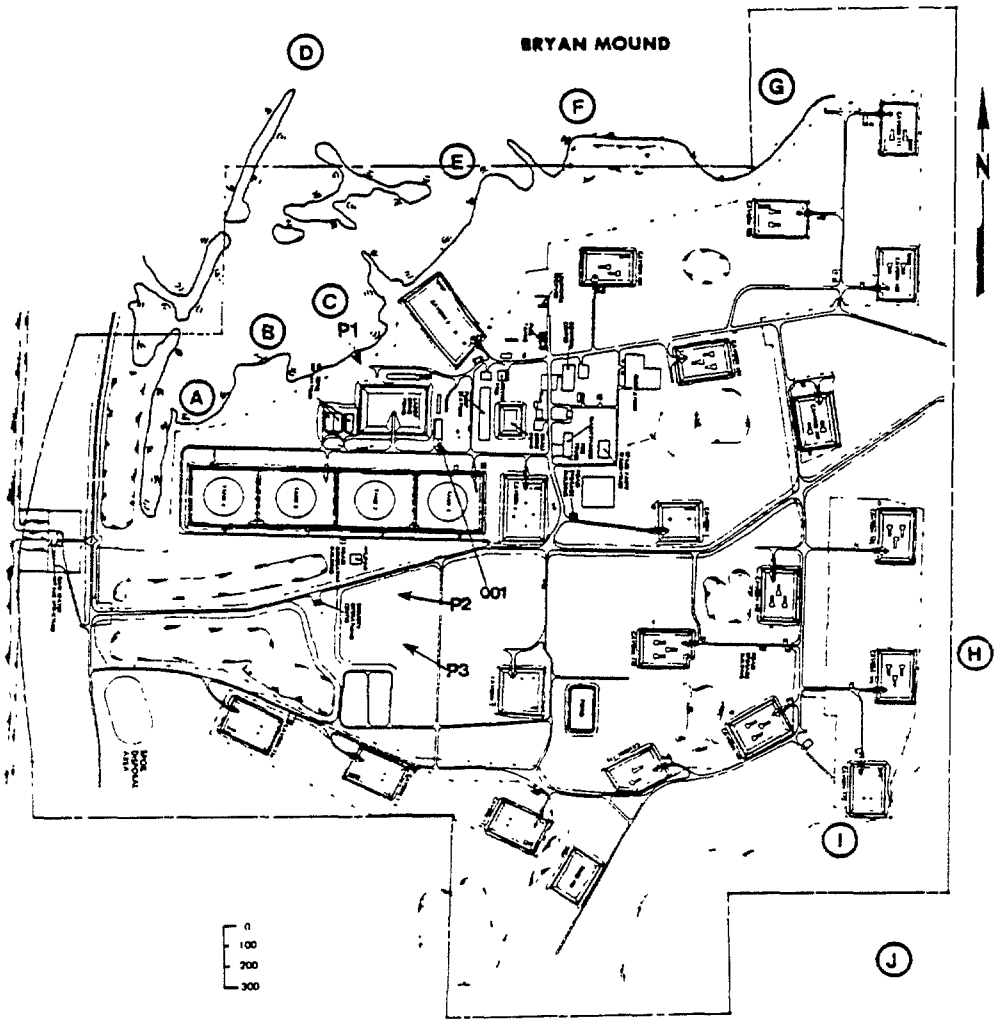

Figure 3-3 (Sheet 1 of 2). Bryan Mound Environmental Monitoring Stations

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 Pads 1, 2, 4, 5 and 101-116

Stormwater Runoff from the High Pressure Pump Pad

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

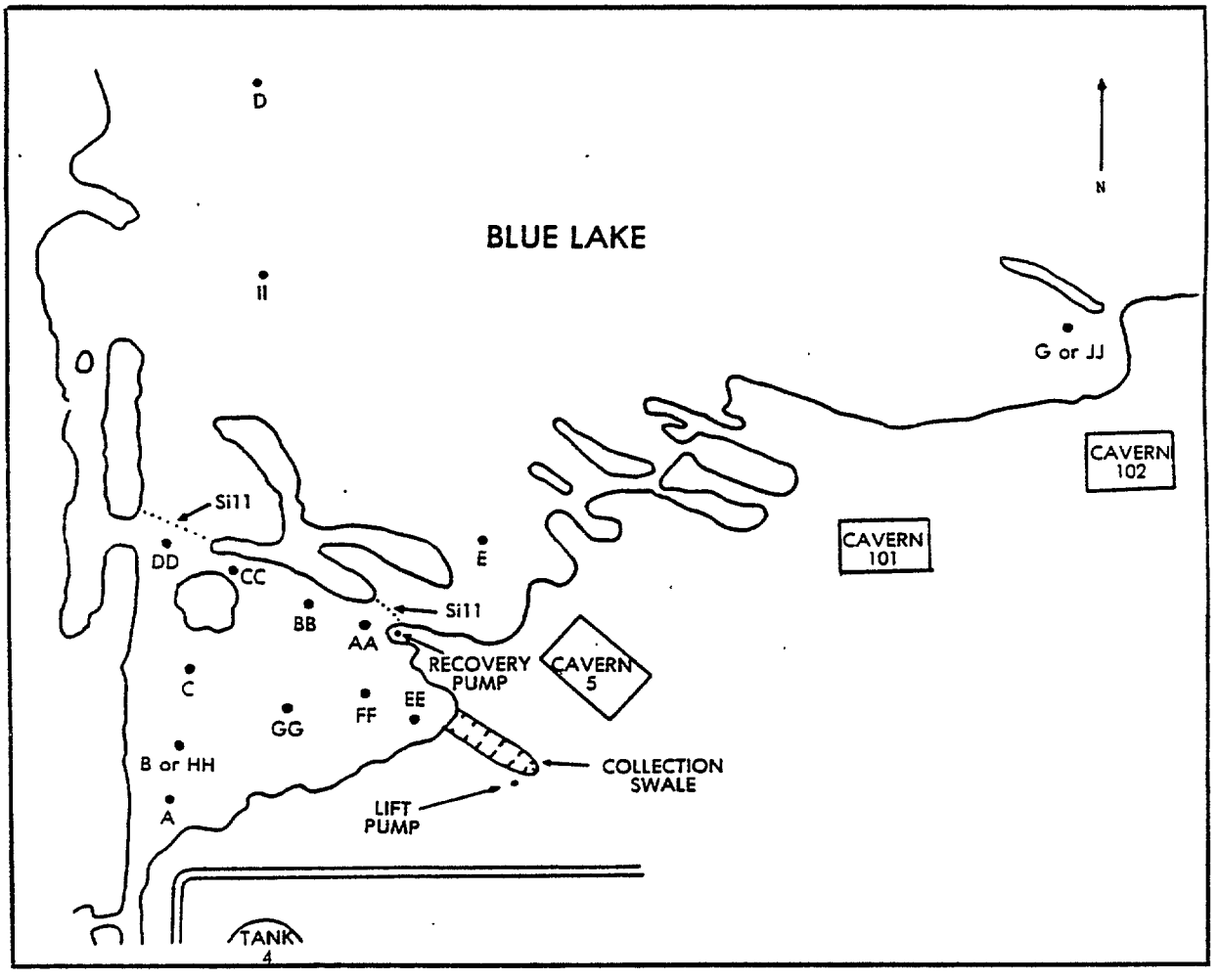

Figure 3-4. Blue Lake Interstitial Monitoring Stations

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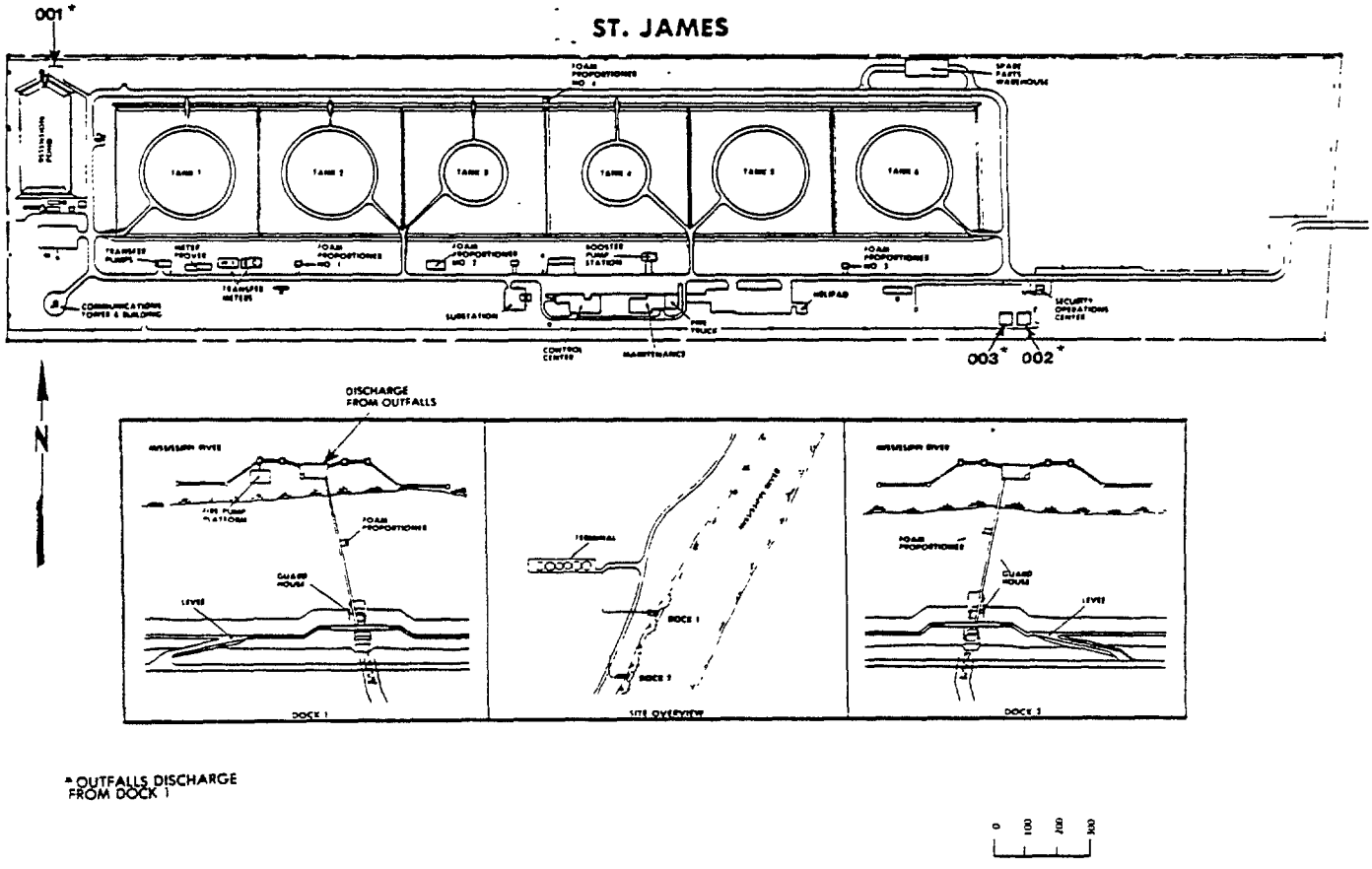

* OUTFALLS DISCHARGE FROM DOCK 1

Figure 3-5 (Sheet 1 of 2). St. James Terminal Environmental Monitoring Stations

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 3-5 (Sheet 2 of 2). St. James Terminal Environmental Monitoring Stations

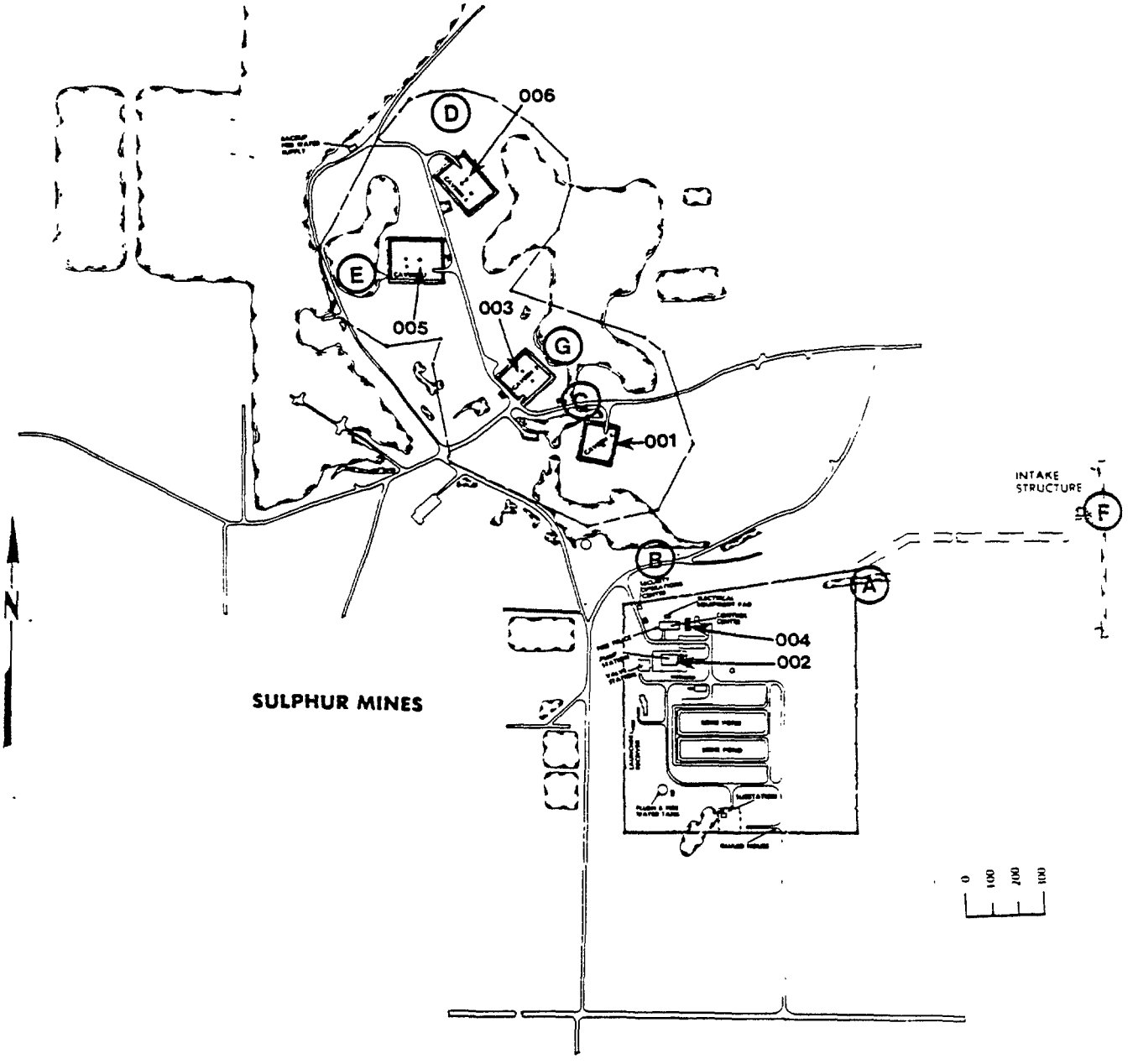

Figure 3-6 (Sheet 1 of 2). Sulphur Mines Environmental Monitoring Stations

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 3-6 (Sheet 2 of 2). Sulphur Mines Environmental Monitoring Stations

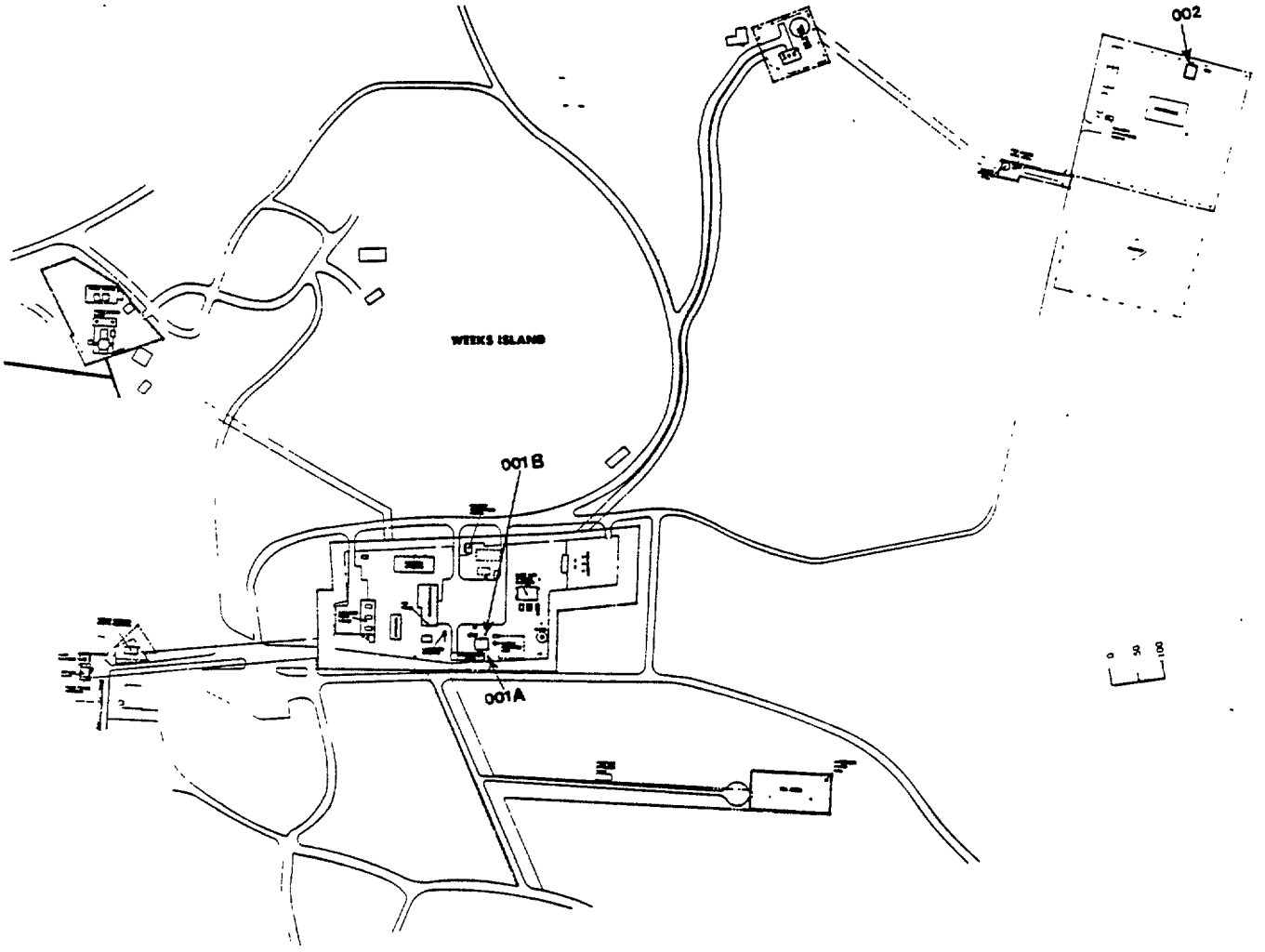

Figure 3-7 (Sheet 1 of 2). Weeks Island Environmental Monitoring Stations

Discharge Monitoring Stations

01A	Stormwater Runoff
01B	Discharge from Sewage Treatment Plant
002	Discharge from Sewage Treatment Plant

Figure 3-7 (Sheet 2 of 2). Weeks Island Environmental Monitoring Stations

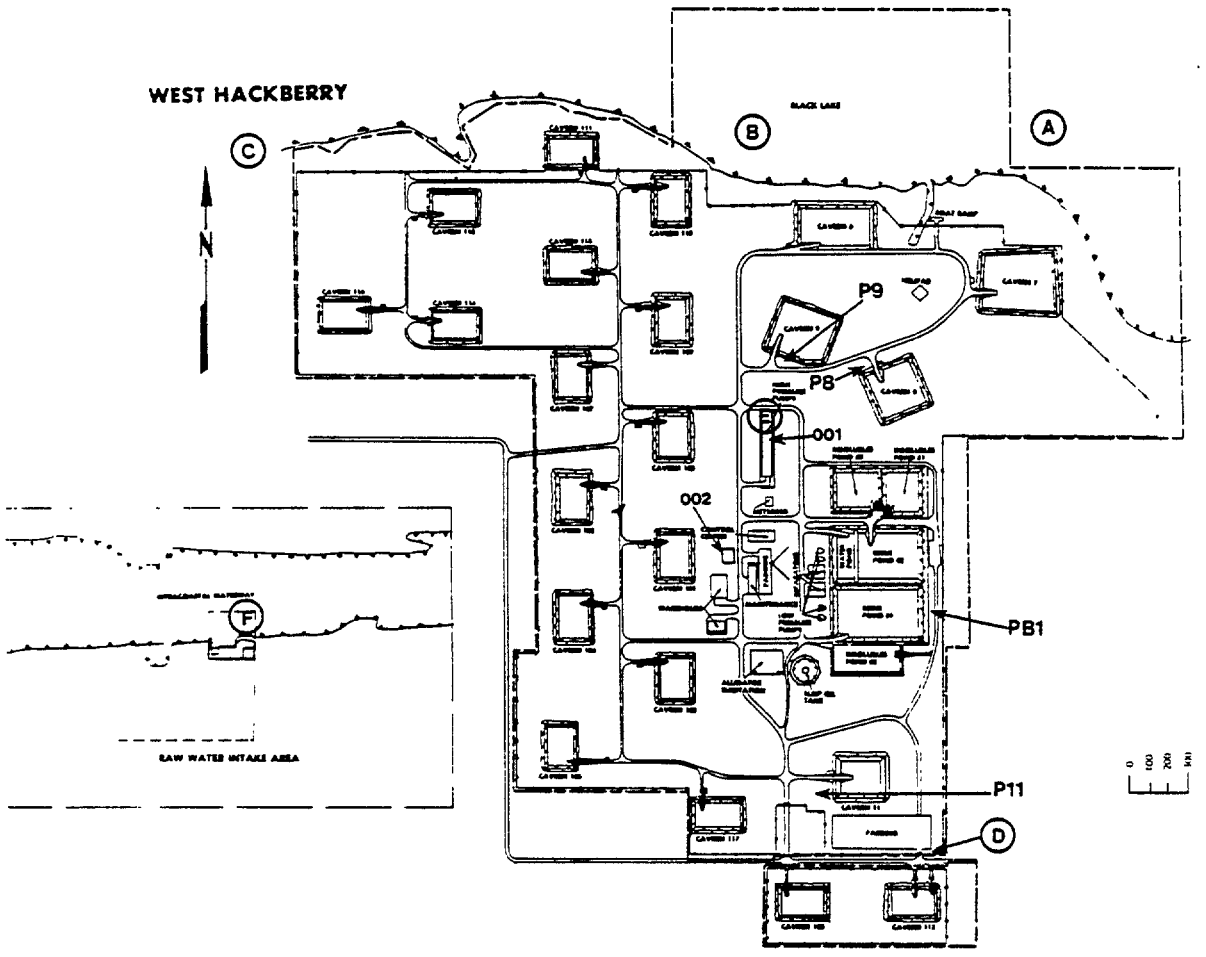

Figure 3-8 (Sheet 1 of 2). West Hackberry Environmental Monitoring Stations

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 6-9, 11, and 101-117

Water Quality Monitoring Stations

A Black Lake

B Black Lake

C Black Lake

D Southeast Drainage Ditch

E High-Pressure Pump Pad

F Raw Water Intake Structure

Figure 3-8 (Sheet 2 of 2). West Hackberry Environmental Monitoring Stations

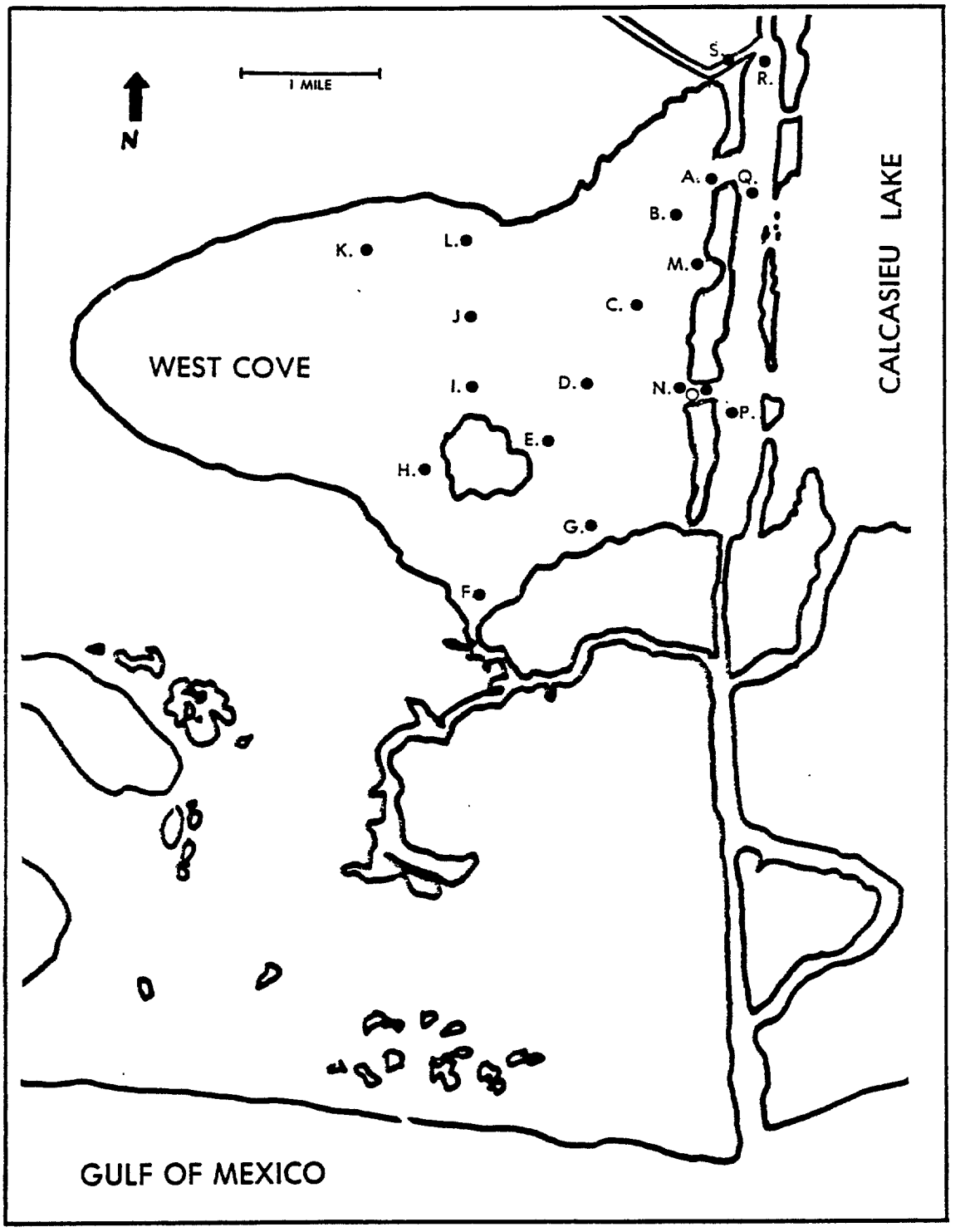

Figure 3-9. West Cove Interstitial and Water Column Monitoring Stations

PHYSICO-CHEMICAL PARAMETERS	SAMPLE IDENTIFICATION AND FREQUENCY BY SITE													
	DAILY					WEEKLY			MONTHLY					Q
	BC	BM	SJ	SM	WH	BM	SM	WH	BC	BM	SM	WI	WH	SJ
pH	003-012 A-D	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	01A 01B 002	002 A-F	002 003
SALINITY		001			001 HPP				A-D	A-J	A-G		A-F	
SPECIFIC CONDUCTIVITY									A-D	A-J	A-G		A-F	
TEMPERATURE		001			001				A-D	A-J	A-G		A-F	
TOTAL DISSOLVED SOLIDS					001	001					A-G		A-F	
TOTAL SUSPENDED SOLIDS					001	001	004		001 002 A-D		A-G	01B 002	002 A-F	002 003
CHLORIDE	010 011													
DISSOLVED OXYGEN					001				A-D	A-J			A-F	
BOD_5							004		001 002 A-D			01B 002	002	002 003
COD		002 TX-001 1,2, 4,5, 101-116								A-J				
OIL & GREASE	003-012 A-D	001 002 101-116 1,2, 4,5, TX-001	001	001 002 003 005 006	001 6-9, 11 101-117 HPP				A-D		A-G	01A	A-C E-F	
TOC			001			001			A-D	A-J			E	
FECAL COLIFORM							004					01B 002	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			01A 01B 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

OUTFALL LOCATION	PERMIT PARAMETER	VALUE / LIMIT	CAUSE
002	TSS	127.5 mg/l / 45.0 mg/l	A freeze damaged pipe caused effluent to leak back into the sewage plant intermixing the aeration chamber and clarifier.
007	pH and Oil & Grease	NO SAMPLE	Discharge pump switch was left in automatic position discharging stormwater before sampling.
001	BOD_5	93.0 mg/l / 45.0 mg/l	Actual cause unknown, but poor quality control procedures suspected in the commercial laboratory used to analyze the sample.
002	BOD_5	47.0 mg/l / 45.0 mg/l	Accumulation of solids in the settling chamber.

Table 3-2. 1985 Noncompliances/Bypasses at Bayou Choctaw

PERMIT NUMBER	ISSUING AGENCY *	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0053040	EPA	Water	8/9/81	3/12/83	(1)
WP0179	LDEQ	Water	7/22/83	7/21/88	
055708	LDNR	Drill	10/1/85	1/1/86	(2)
None	LDNR	Injection	1/11/83	Open	(3)
LMNOD-SE (Iberville Wetlands) 102	COE	Constr.	10/6/83	10/5/83	(4)
LMNOD-SE (GP) NOD-13	COE	Constr.	8/31/85	8/31/90	(5)

(1) Submitted for renewal (2/2/83).
(2) Amended permit to drill for minerals for Cavern 17.
(3) Letter of financial responsibility to LDNR to close, plug, and abandon any and all injection wells.
(4) Excavate and fill to construct and maintain a ring levee, drill site and appurtenances for well pad 101.
(5) Excavate and fill to construct and maintain a ring levee, drill site and appurtenances for well pad 17.

* COE - U.S. Army Corps of Engineers

Table 3-3. Active Permits at Bayou Choctaw

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	Open	(1)
83-ASW-178-NRA	FAA	Constr	4/83	12/84	(2)
C-9256	TACB	Air	5/17/83	Open	(3)
02937,8&9	RCT	Oper	11/28/83	Open	(4)
0048186 0048296	RCT	Oper	5/9/83 6/23/83	Open Open	(5)
02638	TWC	Water	6/27/83	6/26/88	
4045	TWC	Water	11/18/83	Open	(6)

(1) Permit held in suspense until ready to proceed.
(2) Expired. Renewal submitted.
(3) Under construction. Conversion to operations permit should be made 7 months prior to site reaching full status.
(4) Valid until ownership changes, system changes, or other physical changes are made in the system.
(5) Permits to create, operate, and maintain an underground hydrocarbon storage facility consisting of 14 caverns.
(6) Construction must be completed by 11/14/86. Permit expires after consumption of 239,000 acre-feet of water or end of project.

* F&WS - U.S. Fish and Wildlife Service
TDH&PT - Texas Department of Highways and Public Transportation
RCT - Railroad Commission of Texas
TACB - Texas Air Control Board

Table 3-4. Active Permits at Big Hill

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	9/6/85	(2)
3-67-782 (Docket#)	RCT	Injection	8/21/78	Open	(3)
P001447	RCT	Constr.	7/3/85	Open	(4)
P001448	RCT	Constr.	7/3/85	Open	(4)
001447	RCT	Operate	10/30/84	Open	(5)
001448	RCT	Operate	10/30/84	Open	(5)
3-70-377 (Docket#)	TWC	Injection	12/18/78	Open	(3)
3681A	TWC	Water	7/30/79	Open	(6)
02271	TWC	Water	2/3/84	2/2/89	(7)
C-6176B	TACB	Air	7/20/79	Open	(8)
82-8475	TDH&PT	Constr.	1/1/83	Open	(9)
None	Brazoria County	Constr.	12/22/82	Open	(9)

(1) Two-week prior written notification to District Engineer required.
(2) Permit to construct potable water line.
(3) Approval of oil storage and salt disposal program.
(4) Authority to construct anhydrite pit.
(5) Authority to operate brine ponds.
(6) Permit expires after consumption of 367,088 acre-feet of water or project ends.
(7) Corresponds with TX0074012.
(8) Conversion to operations permit should be made 6 months prior to site reaching full status. Modification to existing permit submitted.
(9) Corresponds with SWGCO-RP-16177.

Table 3-5. Active Permits at Bryan Mound

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	Constr.	3/20/78	3/19/88	(2)
WP 0929	LDEQ	Water	9/26/84	9/26/89	
983	LDEQ	Air	7/25/78	Open	(3)

(1) Renewal submitted March 1985.
(2) Amended 10/3/85 to install dolphins at Dock 2. Two-week prior written notification to District Engineer required.
(3) Requires annual operating report.

Table 3-6. Active Permits at St. James Terminal

OUTFALL LOCATION	PERMIT PARAMETER	VALUE / LIMIT	CAUSE
004	BOD_5	275.8 mg/l / 45.0 mg/l	Freezing weather and a weak mixed liquor in the aeration chamber impacted biological activity.
002	pH and Oil & Grease	NO SAMPLE	Pump pad drained due to design failure prior to sample collection.
004	BOD_5	165.0 mg/l / 45.0 mg/l	Lack of aeration due to a sludge blanket buildup in the bottom of the clarifier.
004	BOD_5	183.0 mg/l / 45.0 mg/l	Temporary high organic loading immediately prior to sampling.
004	BOD_5	77.0 mg/l / 45.0 mg/l	Inability to maintain sufficient bacterial buildup due to plant underloading.
004	BOD_5	54.0 mg/l / 45.0 mg/l	Inability to maintain sufficient bacterial buildup due to plant underloading.
004	BOD_5	232.2 mg/l / 45.0 mg/l	High naturally occurring H_2S in seed water caused analysis to indicate an excessive BOD_5.

Table 3-7. 1985 Noncompliances/Bypasses at Sulphur Mines

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LMNOD-SP (LTCS)20	COE	Constr.	7/24/78	7/24/88	(1)
LA0055786	EPA	Water	4/12/80	4/11/85	(2)
1042	LDEQ	Air	9/26/78	Open	(3)
None	LDOTD*	Water	12/14/83	12/31/85	(4)
None	LDNR	Injection	1/11/83	Open	(5)
None	LDNR	Injection	7/20/78	Open	(6)

(1) Renewal submitted 8/13/85 for erosion control work on the Intracoastal Waterway.
(2) Renewal submitted March 1985.
(3) Requires annual operating report.
(4) Water purchase agreement (renewed annually).
(5) Letter of financial responsibility to close, plug, and abandon any and all injection wells.
(6) Approval for use of salt dome cavities for storage of liquid hydrocarbons.

* LDOTD - Louisiana Department of Transportation and Development

Table 3-8. Active Permits at Sulphur Mines

OUTFALL LOCATION	PERMIT PARAMETER	VALUE / LIMIT	CAUSE
002	TSS	57.0 mg/l / 45.0 mg/l	Malfunction of the blower motor timer control.
01B	BOD_5	32.4 mg/l / 30.0 mg/l*	A 10 hour electrical interruption and subsequent intermittent operation of the blower's timers.
01B	Fecal coliforms	TNC ** / 400/100 ml	Improper sized chlorine tablets were used resulting in jamming the feed tube.
01B	BOD_5	38.0 mg/l / 30.0 mg/l*	Bacteria in sewage plant were inadvertently killed by an influx of heavily chlorinated water.
01A, 01B	pH	NO SAMPLE	Instrumentation failure at the typical sampling period prevented the pH measurements. Two subsequent attempts to return with functional equipment were thwarted by Hurricanes Danny and Elena.

* Exceed the monthly average (30 mg/l) rather than the monthly maximum.

** TNC - Too numerous to count.

Table 3-9. 1985 Noncompliances/Bypasses at Weeks Island

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0056243	EPA	Water	6/30/79	10/13/87	
LMNOD-SP (Atchafalaya Floodway) 251	COE	Constr.	9/12/84	Open	(1)
1105	LDEQ	Water	1/30/78	Open	(2)
SDS-8 (Order #1)	LDNR	Injection	2/16/79	Open	(3)
None	LDEQ	Water	7/12/79	Open	

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

Table 3-10. Active Permits at Weeks Island

OUTFALL LOCATION	PERMIT PARAMETER	VALUE / LIMIT	CAUSE
002	BOD_5	17.8 mg/l / 15.0 mg/l	Periodic peak overloads due to insufficient plant capacity. The sewage plant was shut down until design changes could be made.
001	Velocity	24.4 ft/sec / 25.0 ft/sec	Problems encountered during startup of pumps prevented achievement of the minimum nozzle exit velocity from the brine disposal pipeline.
001	Oil & Grease	24.0 mg/l / 15.0 mg/l	The sample was collected during brine line startup in an area where spilled motor oil had accumulated.
001	NO SAMPLE TAKEN		
HPP	Oil & Grease	43.1 mg/l / 15.0 mg/l	Heavy rains flushed light lubricating oil collected in the oil-water separator out of the outfall.

Table 3-11. 1985 Noncompliances/Bypasses at West Hackberry

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	10/26/87	(1)
LMNOD-SP (Black Lk)43	COE	Constr.	7/26/84	7/25/87 8/1/94	(2) (1)
None	LDNR	Injection	8/7/79	Open	(3)
971198-9	LDNR	Injection	10/6/83	Open	(4)
None	LSCC	Water	3/30/79	Open	
1048	LDEQ	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.

Table 3-12. Active Permits at West Hackberry

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. The Bryan Mound and West Hackberry laboratories participated in the fifth annual EPA Discharge Monitoring Report Quality Assurance Study during 1985. A structured ongoing laboratory quality assurance program has been implemented through the systematic application of acceptable accuracy and precision criteria at all SPR laboratories. Compliance with this and other environmental program requirements was reviewed and evaluated at each site by means of internal annual audits and audits at select sites by state and federal environmental agencies.

4.1 EPA DISCHARGE MONITORING REPORT QUALITY ASSURANCE STUDY

The EPA entered the fifth year of its Discharge Monitoring Report Quality Assurance program. Through this program EPA provides analytical laboratories of major NPDES dischargers blind samples of permit parameters for analysis. The permittee analyzes these samples and submits the data to EPA for evaluation of analytical accuracy relative to the performance of EPA referee laboratories. The Bryan Mound and West Hackberry laboratories each participated in this program during 1985 for the fifth time in as many years.

The analytical data submitted to EPA by the Bryan Mound and West Hackberry laboratories were well within acceptance limits. Unconditional acceptability is defined as falling within $\pm$ 1.5 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:

Parameter	Bryan Mound	West Hackberry
pH (std. units)	0.00	-0.33
TSS (mg/l)	+0.38	+0.27
Oil and Grease (mg/l)	-0.26	-0.09
TOC (mg/l)	-0.16	+0.41
COD (mg/l)	+0.70	N/A
BOD_5 (mg/l)	N/A	-0.89

These data, are within the unconditional acceptable limits and reflect the high quality of analysis performed by the Bryan Mound and West Hackberry laboratories.

4.2 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.

The EPA quality control document advocates use of quality control charts to maintain and evaluate accuracy and precision data. 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 of quality control charts preparation. This software has been implemented at each SPR laboratory. During 1985 state or federal agency auditors have examined the SPR laboratories' precision and accuracy data and found this data, the program, and methodology in order.

4.3 ENVIRONMENTAL DEPARTMENT AUDITS

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

The 1985 environmental audits at each SPR site showed the overall implementation and execution of the SPR Environmental Program to be outstanding. An especially noteworthy observation during these audits was the high level of environmental awareness exhibited among all site personnel. MOM contractor management has placed a high priority on fulfilling the intent and conditions of the SPR Environmental Program.

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Office of Environmental Audit and Compliance, Washington, D.C.

Oak Ridge Operations Office, Assistant Manager for SPR, Oak Ridge, TN

Oak Ridge Operations Office, Assistant Manager for Safety and Environment, Oak Ridge, TN

Oak Ridge Operations Office, Safety and Environmental Control Division, Oak Ridge, TN

SPR Program Office, Washington, D.C.

SPR Project Management Office, New Orleans, LA

Technical Information Center, Oak Ridge, TN