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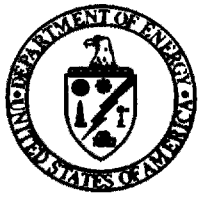


UNITED STATES DEPARTMENT OF ENERGY

STRATEGIC PETROLEUM RESERVE

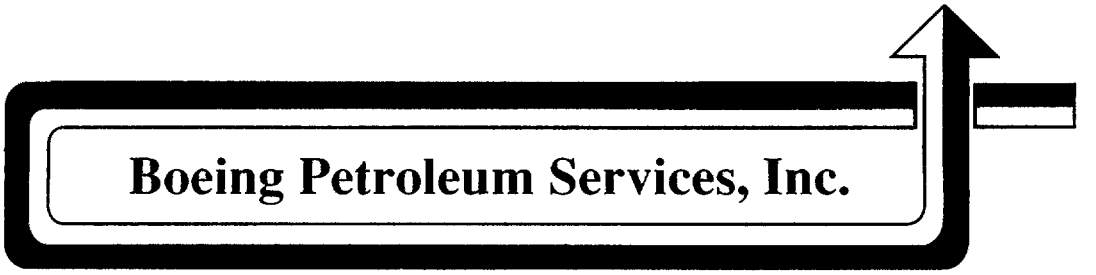
ANNUAL SITE

ENVIRONMENTAL REPORT

FOR

CALENDAR YEAR 1991

STRATEGIC PETROLEUM RESERVE



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ENVIRONMENTAL REPORT

FOR

CALENDAR YEAR 1991

Document No. D506-04003-09

Prepared for the Department of Energy
Strategic Petroleum Reserve Project Management Office
under Contract No. DE-AC96-85PO21431

BOEING PETROLEUM SERVICES, INC.
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New Orleans, Louisiana 70123

June, 1992

DISCLAIMER

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ABBREVIATIONS AND ACRONYMS

ac	acre
adj	adjacent
AFFF	aqueous film forming foam
ARCO	Atlantic Richfield Company
AST	above ground storage tanks
avg	average
bbl	barrel(s) (1bbl = 42 gallons)
BC	Bayou Choctaw
BH	Big Hill
BM	Bryan Mound
bldg	building
BOD5	five day biochemical oxygen demand
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curies
COD	Chemical Oxygen Demand
cm	centimeter
COE	United States Army Corps of Engineers
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DO	dissolved oxygen
DOE	United States Department of Energy
EPA	United States Environmental Protection Agency
ERT	Emergency Response Team
ESA	Endangered Species Act
F&WS	United States Fish and Wildlife Service
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
ft	feet
gpd	gallons per day
in	inch
ha	hectacre
kg	kilogram
km	kilometers

LA	Louisiana
lab	laboratory
lbs	pounds
LDEQ	Louisiana Department of Environmental Quality
LDHHR	Louisiana Department of Health and Human Resources
LDNR	Louisiana Department of Natural Resources
LDOTD	Louisiana Department of Transportation and Development
LDWF	Louisiana Department of Wildlife and Fisheries
m/sec	meters per second
m	meters
m3	cubic meters
MACT	Maximum Available Control Technology
maint	maintenance
max	maximum
mCi	millicuries
mg/l	milligrams per liter
mi	miles
min	minute
MMB	million barrels
NE	northeast
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NORM	naturally occurring radioactive material
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NW	northwest
O&G	oil and grease
OPS	operations
P&A	plug and abandon
PCB	polychlorinated biphenyls
pCi	prcocuries

pH	negative logarithm of the hydrogen ion concentration (acidic to basic on a scale of 0 to 14, 7 is neutral)
ppm	parts per million
ppt	parts per thousand
QA	Quality Assurance
RCRA	Resource Conservation and Recovery Act
RCT	Railroad Commission of Texas
RQ	reportable quantity
RWIS	raw water intake structure
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SE	southeast
SJ	St. James
SM	Sulphur Mines
SPR	Strategic Petroleum Reserve
STN	station
STP	sewage treatment plant
S.U.	standard units
SW	southwest
TACB	Texas Air Control Board
TDH	Texas Department of Health
TDH&PT	Texas Department of Highways and Public Transportation
TDS	total dissolved solids
TOC	total organic carbon
TPY	tons per year
TSCA	Toxic Substance Control Act
TSD	treatment, storage, and disposal
TSS	total suspended solids
TWC	Texas Water Commission
TX	Texas
UIC	Underground Injection Control
UST	underground storage tank
USCG	United States Coast Guard
VOC	volatile organic compound
WH	West Hackberry
WI	Weeks Island

EXECUTIVE SUMMARY

This report, provided annually in accordance with DOE Order 5400.1, summarizes monitoring data collected to assess Strategic Petroleum Reserve (SPR) impacts on the environment. The report serves as a management tool for mitigating such impacts, thus serving the public interest by ensuring environmentally sound operation of the SPR.

Included in this report is a description of each site's environment, an overview of the SPR environmental program, and a recapitulation of special environmental activities and events associated with each SPR site during 1990. The active permits and the results of the environmental monitoring program (i.e., air, surface water, groundwater, and water discharges) are discussed within each section by site. The quality assurance program is presented which includes results from laboratory and field audits and studies performed internally and by regulatory agencies.

In general, no significant adverse environmental impact resulted from any SPR activities during 1990. Environmental areas of concern, such as potential groundwater contamination, are fully addressed in the applicable section by site. The SPR continues to maintain an overall excellent environmental record.

1. INTRODUCTION

The creation of the Strategic Petroleum Reserve (SPR) was mandated by Congress in Title I Part B of the Energy Policy and Conservation Act (P.L. 94-163), of December 22, 1975. The SPR provides 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 facilities (four in Louisiana and two in Texas), a marine terminal facility (in Louisiana), and an administrative facility (in Louisiana). Figure 1-1 is a regional map showing the relative location of SPR facilities. Four of the sites were acquired with existing solution mined caverns, three of which have had additional solution mining. A fifth site, room and pillar salt mine, was acquired with storage previously created by mechanical underground mining techniques. The sixth storage site was created by new solution mining. Two sites (Bayou Choctaw and Big Hill) are being expanded by solution mining to create the mandated storage capacity. Sulphur Mines, the smallest of the SPR sites, transferred its crude oil to Big Hill and West Hackberry in preparation for the decommissioning and planned sale of the site.

The pipeline terminals currently used by the SPR are the ARCO Terminal (Texas City, Texas), the Sunoco Pipeline Terminal (Nederland, Texas), and the Capline Pipeline Terminal (St. James, Louisiana). The sites are also capable of distributing crude oil via tankships. The ARCO pipeline connecting the Bryan Mound site with the Texas City, Texas, docks and area refineries was completed in 1987. A second pipeline connecting the West Hackberry site to refineries in Lake Charles, Louisiana, and Beaumont - Port Arthur, Texas areas via the Texas 22 pipeline was completed in 1989. Access to adjacent commercial dockage was completed in 1988 for the St. James Terminal with the installation of a short segment of pipeline connecting the nearby Shell Capline facility. An additional tie-in to the Koch pipeline has also been completed.

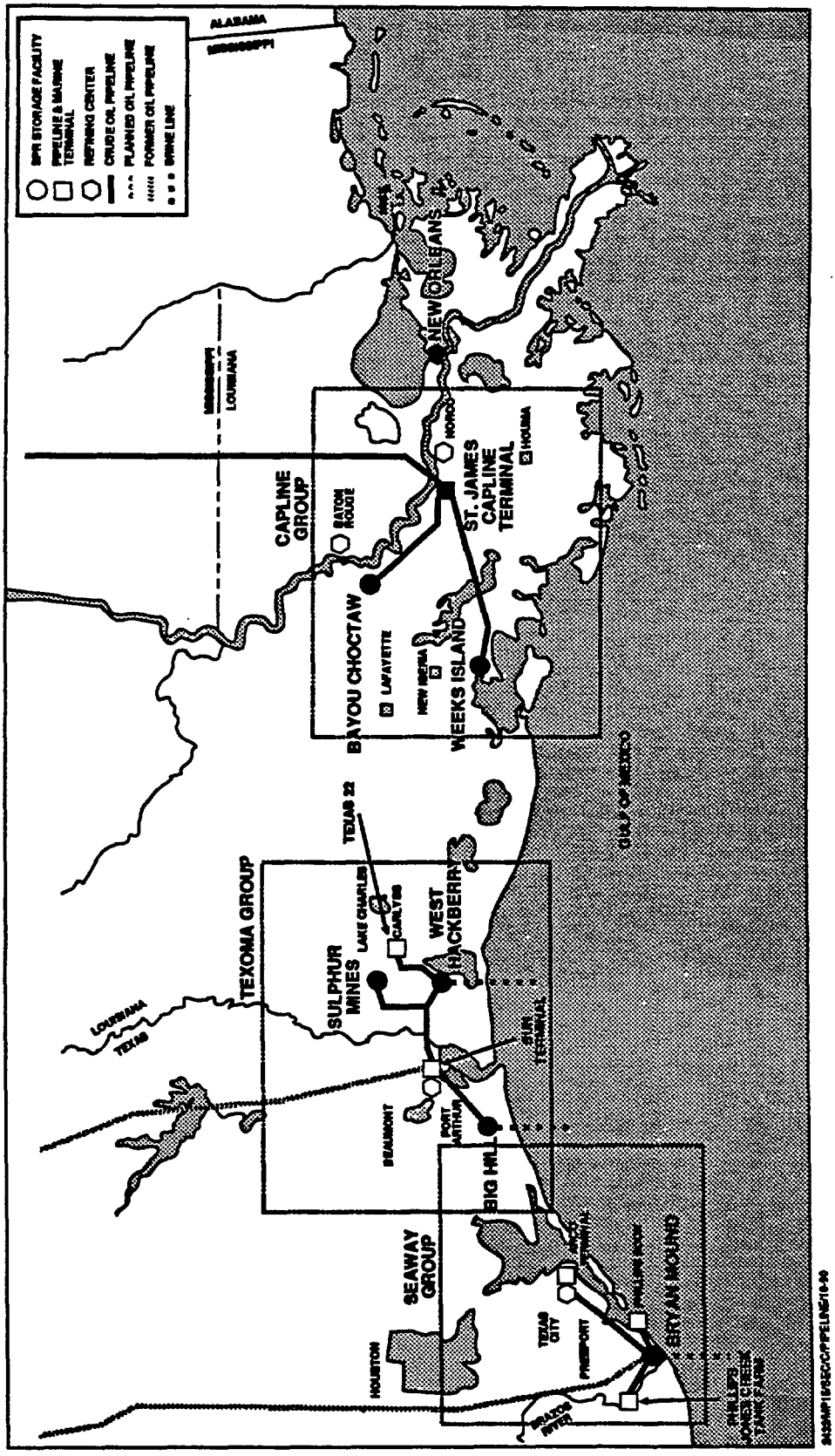

Figure 1-1. SPR Site Locations

The SPR is planning to expand from 750 million barrel (MMB) storage capacity to 1 billion barrels. The Environmental Impact Statement addressing various alternatives and the impacts of each is in progress. In addition, conceptual designs have been initiated.

Descriptions of the individual sites with photographs (Figures 1-2 through 1-8), follow. Figures 5-1 through 5-7 provide the site specific configurations.

1.1 BAYOU CHOCTAW

The Bayou Choctaw (BC) site is located on the west side of the Mississippi River 19.3 km (12 mi) southwest of Baton Rouge in Iberville Parish, Louisiana (Figure 1-2). The site consists of a primary operational area and a brine disposal area occupying approximately 69 and 81 ha (168 and 200 ac) 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, the Louisiana State Capitol and the major source of housing and services for the site, is within easy commuting distance.

The habitat surrounding the site is a freshwater swamp. Elevation ranges from approximately 1.5 to 3.0 m (5 to 10 ft) 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 4.9 hectare (12 acre) lake (Cavern Lake) on the north side of the site.

Figure 1-2. Bayou Choctaw SPR Site

Bottomland hardwood forest and deciduous swamps are predominant at the Bayou Choctaw site. The vegetation at the site includes baldcypress, sweetgum, tupelo (characteristic of lowland 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, American anhinga, and American woodcock. Inhabitants of the bottomland forest and swamp include opossum, squirrels, nutria, mink, river otter, raccoon, swamp rabbit, white-tailed deer, and snakes. The American alligator, threatened by similarity of appearance, is frequently found in and adjacent to the site. The southern bald eagle has one nest within one mile of the Bayou Choctaw - St. James crude oil pipeline.

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 one km (0.6 mi) 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.

The Bayou Choctaw site will be used to store 11.4 million m^3 (72 MMB) of crude oil. Currently, there are six solution-mined caverns at this storage site. An existing cavern, Number 18, is being expanded to enhance the overall storage capacity of the Bayou Choctaw SPR site.

Raw water is provided from Cavern Lake. Brine is transported via pipeline to 12 brine disposal wells located approximately two miles south of the site. There is a 58 km (36 mi), 91 cm (36 in) crude oil pipeline connecting the site to the St. James Terminal.

1.2 BIG HILL

The Big Hill (BH) site is located in Jefferson County, Texas, approximately 109 km (68 mi) east of Houston, 37 km (23 mi) southwest of Port Arthur, and 14 km (9 mi) north of the Gulf of Mexico. Only small unincorporated communities are located near the site. The rural area around the site (Figure 1-3) is used primarily for rice farming, cattle grazing, and oil and gas production. The permanent work force 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 construction phase, much of the transient skilled labor was brought in from Houston, Galveston, or Lake Charles. The site is situated on approximately 111 ha (275 ac) of land on the Big Hill salt dome. Surface elevations reach 10 m (35 ft) above sea level, the highest elevations in the region. The agricultural and pasture land uses around Big Hill are typical of the region.

Approximately one km (.6 mi) 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 five km (3 mi) south of the site, which connects to the Intracoastal Waterway located three km (2 mi) further south and oriented in a northeast to southwest direction. Freshwater impoundments are located

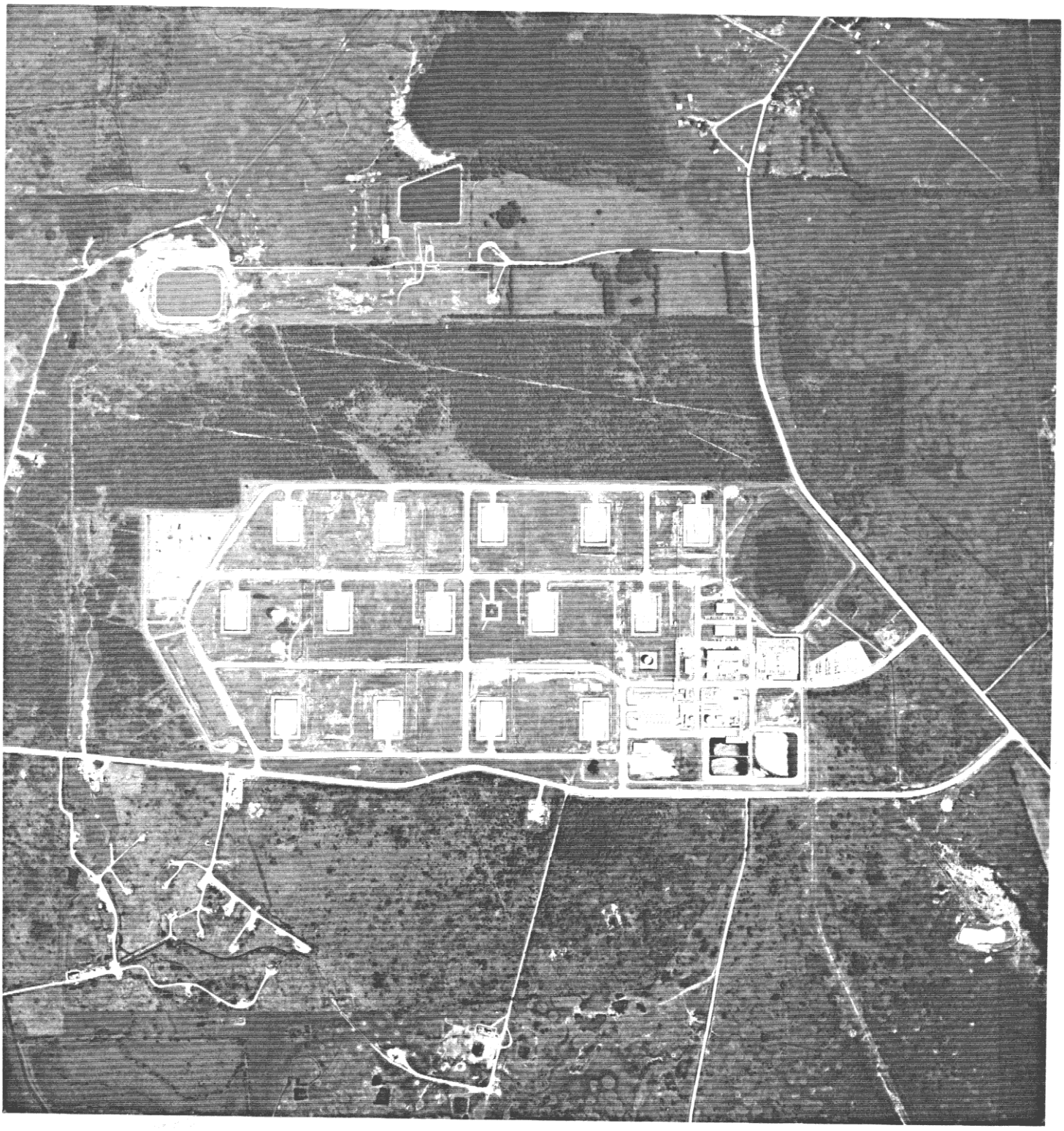

Figure 1-3. Big Hill SPR Site

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. Natural ridges (cheniers) paralleling the coastline isolate the marsh from the Gulf of Mexico.

Existing habitats in the vicinity of the site are related to agricultural use. There are petroleum-related industrial operations on and off the salt dome which have altered land use. There are two natural ponds present on the eastern edge of the dome, one of which is located on the northeast corner of the site and the other just north of the site.

The upland habitat, which comprises the majority of the site, consists of many tall grasses such as bluestem, indiangrass, switchgrass, and prairie wildgrass. A few 150 year old live oak trees are present on site. Fauna typical in the area include coyote, rabbits, raccoon, rodents, snakes, turtles, and numerous upland game birds and passerines. The nearby ponds and marsh south of the site provide excellent habitat for the American alligator, threatened by similarity of appearance. No other known species that frequent the site are endangered or threatened. The McFaddin National Wildlife Refuge located south of the site provides important habitat for overwintering waterfowl.

The Big Hill site is planned for the storage of 25.6 million m^3 (160 MMB) of crude oil in 14 caverns. Appurtenant facilities include a raw water intake structure on the Intracoastal Waterway with a 107 cm (48 in) pipeline extending to the site, a 107 cm (48 in) brine disposal pipeline extending 8 km (5 mi) offshore in the Gulf of Mexico, and a 91 cm (36 in) pipeline for

transporting crude oil between the site and the Sunoco Terminal in Nederland, Texas. The brine pipeline has a series of brine diffuser nozzles which operate to promote brine dispersion.

Drilling and construction commenced in 1983 at the site. Actual leaching (solution mining) of the oil storage caverns began in October 1987 and is was completed in 1991.

1.3 BRYAN MOUND

The Bryan Mound (BM) site is located in Brazoria County, about 105 km (65 mi) due south of Houston, Texas, and five km (3 mi) south of Freeport, Texas, on the east bank of the Brazos River Diversion Channel, near the Gulf of Mexico. The area is highly industrialized, and includes several petrochemical related facilities. Approximately 50 percent of the area's population are between 20 and 55 years of age and work in the local area, although many commute to work from outside the immediate vicinity.

The site occupies 237 ha (586 ac) 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. Levees, protecting the town of Freeport, form a second 5.5 square km (3.5 sq mi) 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 essentially bisecting the site.

Figure 1-4 shows the major water bodies near the site, Blue Lake to the north, and Mud Lake to the southeast. These water bodies generally define the mounded aspect of the Bryan Mound dome, which creates a surface expression in the terrain by rising approximately five m (15 ft) above the surrounding wetlands. Although Blue Lake is within the protective triangle formed by the levee system (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 also occur in unmowed "natural" site areas. 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. Migratory waterfowl, common egret, snowy egret, great blue heron, killdeer, least tern, and black-necked stilt (the latter two are Texas state-protected species), as well as nutria, raccoon, skunk, rattlesnakes, turtles, and frogs can be found on

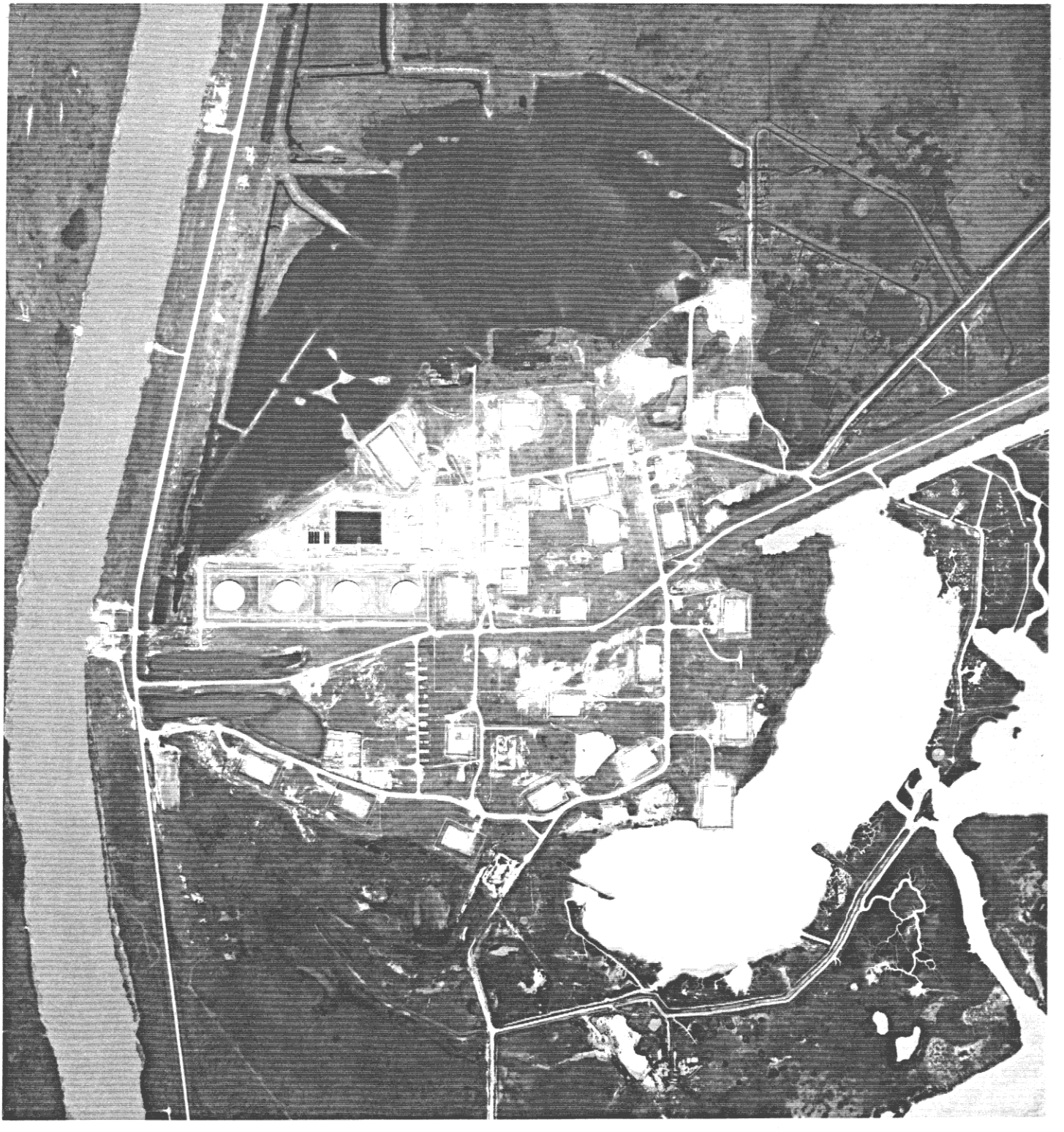

Figure 1-4. Bryan Mound SPR Site

and in the area surrounding Bryan Mound. No federally endangered or threatened species are found on site.

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.

A total storage capacity of 35.9 million m^3 (226 MMB) of crude oil in 20 solution-mined caverns is planned for Bryan Mound. Appurtenant facilities include a 91 cm (36 in) brine disposal pipeline extending 20.1 km (12.5 mi) into the Gulf of Mexico; a raw water intake structure adjacent to the site on the Brazos River Diversion Channel, two 76 cm (30 in) crude oil pipelines connecting the site to the Jones Creek Tank Farm 4.8 km (3 mi) northwest of the site, the Phillips docks 6.4 km (4 mi) northeast of the site, and the 102 cm (40 in), 73.6 km (46 mi) crude oil pipeline from the site to the ARCO Refinery in Texas City. A series of brine diffuser nozzles, located at the end of the brine pipeline, are operated to promote brine dispersion.

1.4 ST. JAMES TERMINAL

The St. James Terminal (SJ) consists of six aboveground storage tanks (total capacity 0.3 million m^3 or two MMB) and two tanker docks, as seen in Figure 1-5. The tank farm area occupies 42.5 ha (105 ac) and the docks occupy 19.4 ha (48 ac). The terminal has separate crude oil pipelines connecting it with Weeks Island and Bayou Choctaw. The site is located on the west bank of the Mississippi River, approximately halfway between New Orleans and Baton Rouge, Louisiana, and 3.1 km (1.9 mi) 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

Figure 1-5. St. James SPR Terminal

thoroughfare in the area. Although some of the work force may commute from New Orleans or Baton Rouge, the majority of the workers are from local labor pools.

The terminal is bounded 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 (the batture) is a freshwater wetland that is inundated during high water periods. 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. No federally endangered or threatened species are found on site.

1.5 SULPHUR MINES

The Sulphur Mines (SM) site, approximately 71 ha (175 ac), is located in Calcasieu Parish, 2.4 km (1.5 mi) west of the town of Sulphur, Louisiana (Figure 1-6). 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. Four brine disposal wells are located on property owned by the Pittsburgh Plate Glass Company approximately 3.5 km (2.2 mi) southwest of the main site.

Due to the area land contours and differing terrain types, the site is divided into two operational areas, primary (administrative) and secondary (caverns). The secondary site area is bordered on the west, northeast,

Figure 1-6. Sulphur Mines SPR Site

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 0.4 km (1/4 mi) east of the site. Changes in elevation throughout the site are minor, with most of the site four to six m (15 to 20 ft) above sea level. The site proper is normally dry except in the spring season or during heavy rains when high waters sometimes flood portions of it. The lowest elevations are over the center of the dome, where subsidence has occurred as a result of prior sulfur mining activity. Much of the surrounding area is covered with a mixed pine/hardwood forest.

Mammals on site and in the surrounding area include white-tailed deer, raccoon, fox squirrel, cottontail rabbit, opossum, striped skunk, armadillo, nutria, southern flying squirrel, white-footed mouse, and bobcat. Snakes, turtles, frogs, and toads can also be found. Crappie, largemouth bass, sunfish, gar, carp, bowfin, and catfish inhabit shallow ponds on the site. Many bird species including egrets, killdeer, herons, and migratory waterfowl are present. The American alligator, threatened by similarity of appearance, can be found on site. No federally endangered or threatened species are found on site.

Sulphur Mines stored 4.1 million m^3 (26 MMB) of crude oil in five existing solution-mined caverns three of which form a single gallery. The site is connected to the Sunoco Terminal in Nederland by a 41 cm (16 in), 25.6 km (16 mi) crude oil pipeline which connects to the West Hackberry 107 cm (42 in) line at the Gulf Intracoastal Waterway. However, this connection will be broken prior to divestiture. Brine disposal was via injection into

four brine disposal wells located approximately two miles (3.2 km) southwest of the site. Transfer of the oil in storage began December 1990 and was completed in early 1992. Abandonment of Sulphur Mines will improve the efficiency and cost effectiveness of oil storage on the SPR.

1.6 WEEKS ISLAND

The aboveground facility, shown in Figure 1-7, occupies approximately three ha (7 ac) and is located in Iberia Parish, Louisiana, about 22 km (14 mi) 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 (WI) 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 same dome. The land surface over the salt dome forms an "island" caused by domal upthrusting and includes the highest elevation, 52 m (171 ft) above sea level, in southern Louisiana. The area surrounding the island is a combination of marsh, bayous, manmade canals (including the Intracoastal Waterway), 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 common at the higher elevations. The predominant tree species are oak, magnolia, and hickory, which extend down to the surrounding marsh. Pecan trees

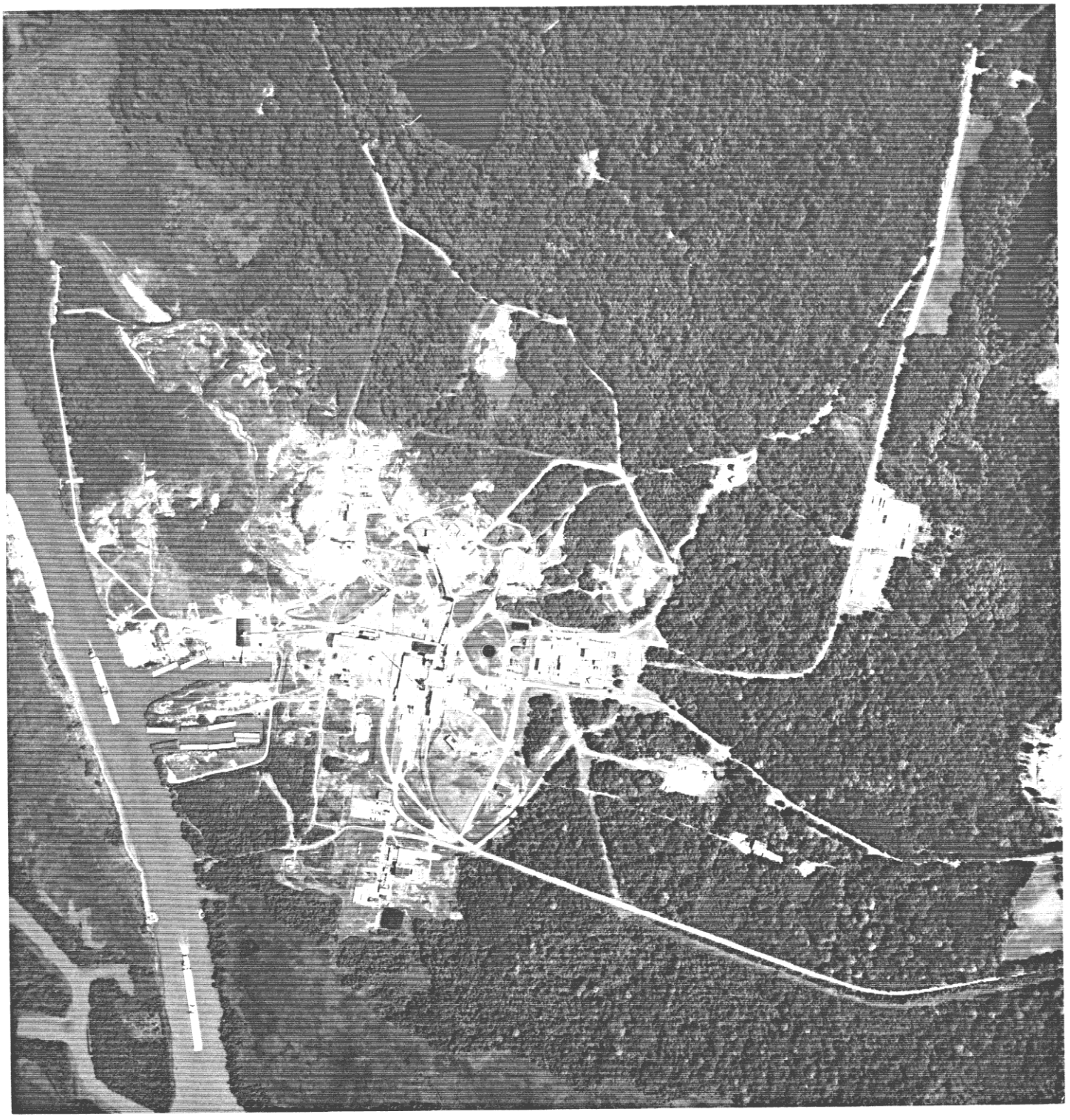

Figure 1-7. Weeks Island SPR Site

are also present. Gulls, terns, herons, and egrets are common in the marsh area. Mink, nutria, river otter, and raccoon are the most common inhabitants of the intermediate marshes. Other mammals found at Weeks Island are opossum, bats, squirrels, swamp rabbit, bobcat, white-tailed deer, and coyote. The black bear has recently been added to the Federal Threatened Species list. The American alligator occurs in the marshes adjacent to the site.

The water bodies surrounding Weeks Island provide a vast estuarine nursery ground for an array of commercially and recreationally important finfish and shellfish.

The Weeks Island site consists of a large mechanically excavated (room and pillar type) salt mine with 11.6 million m^3 (73 MMB) of crude oil storage capacity. In addition to normal site facilities, there is a 91 cm (36 in) 108 km (67 mi) long crude oil pipeline connecting the site to the St. James Terminal.

1.7 WEST HACKBERRY

The West Hackberry (WH) site is located in Cameron Parish 29 km (18 mi) southwest of Lake Charles, Louisiana and 26 km (16 mi) 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 from local residents of the Hackberry community, the towns of Sulphur and Lake Charles, in Calcasieu Parish, and from recent arrivals to the area.

The site is situated on 229 ha (565 ac) of land on top of the West Hackberry salt dome (Figure 1-8). The dome is

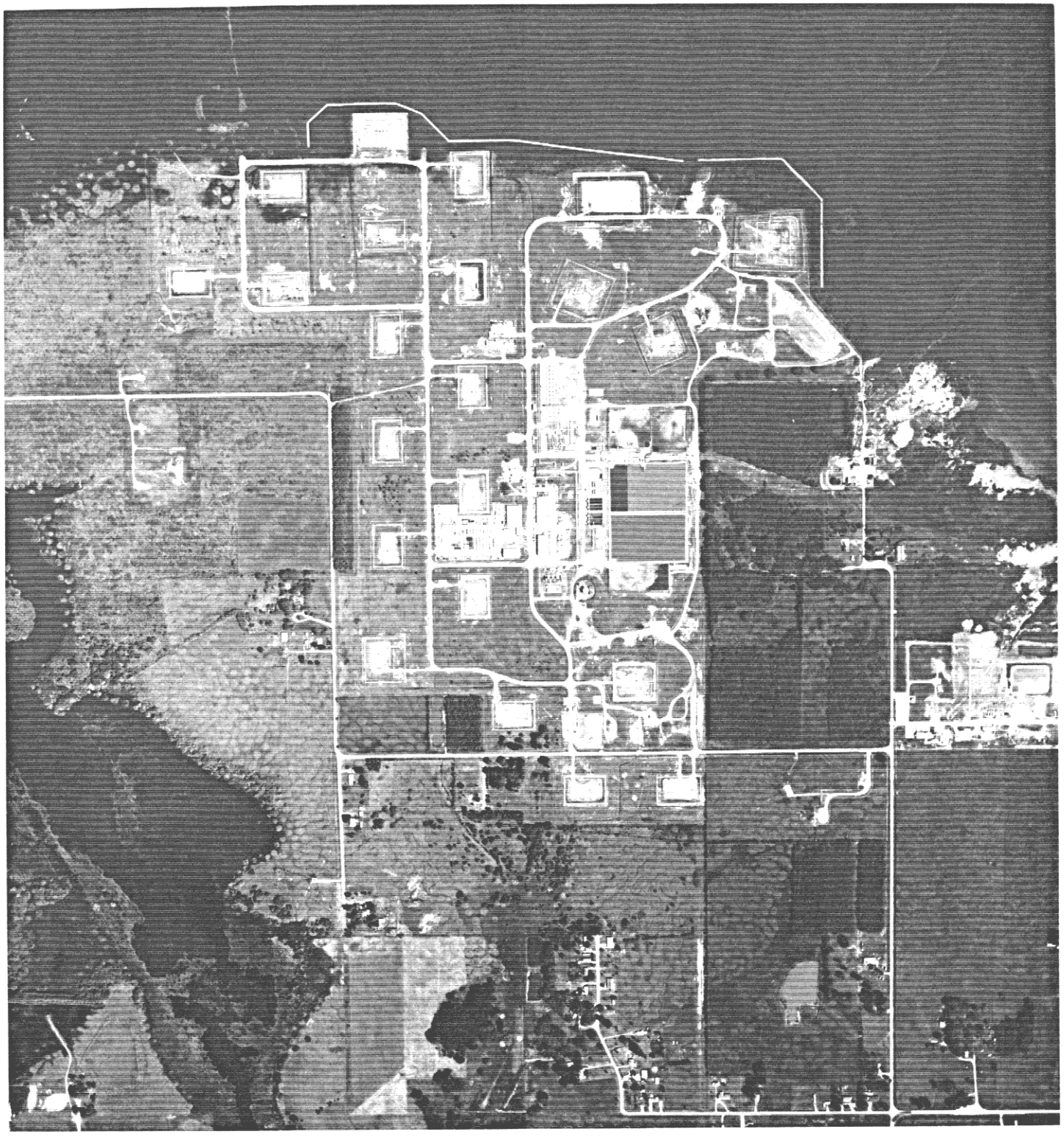

Figure 1-8. West Hackberry SPR Site

covered by a distinct mounded overburden on its western portion, with elevations up to nearly 6.5 m (21 ft), the highest point in Cameron Parish. The majority of the dome is approximately 1.5 m (5 ft) above sea level. Two brine disposal well pads occupying approximately 2.5 ha (6 ac) are located 3 km (1.9 mi) south of the site.

Waterways near the site include Calcasieu Lake and the Calcasieu Ship Channel approximately five km (3 mi) to the east, and the Intracoastal Waterway approximately six km (4 mi) north of the site. Black Lake, a brackish water lake, borders the dome on the northern and western sides. Numerous canals and natural waterways, including Black Lake Bayou, connect Black Lake to Alkali Ditch and then to the Intracoastal Waterway on the eastern side of the site. Black Lake Bayou, referred to locally as Kelso 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. American alligator, snakes, egrets, herons, roseate

spoonbill, migratory waterfowl, red-tailed hawk, red fox, raccoon, nutria, opossum, rabbits, and white-tailed deer inhabit the area surrounding the West Hackberry site. Aquatic inhabitants of Black Lake include crabs, shrimp, drum, croaker, spot, sheepshead, mullet, gar, redfish, and catfish. There are no endangered or threatened species other than the alligator (threatened by similarity of appearance) on site.

The West Hackberry site will store 34.8 million m^3 (219 MMB) of crude oil in 22 solution-mined caverns. Brine is transported and disposed either by injection into eight active brine disposal wells, or the Gulf of Mexico through a 91 cm (36 in), 42 km (26 mi) pipeline at an area 11 km (7 mi) south of Holly Beach, Louisiana. A series of brine diffuser nozzles are operated to promote brine dispersion. 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, Texas, via a 107 cm (42 in), 66 km (42 mi) crude oil pipeline.

2. COMPLIANCE SUMMARY

2.1 BACKGROUND AND OVERVIEW

The Strategic Petroleum Reserve (SPR) operates in conformance with requirements established by a number of Federal and state statutes and regulations, Executive Orders and Department of Energy (DOE) Orders. Compliance status with regard to major environmental statutes is summarized below.

Prior to the "Tiger Team" assessment, the SPRPMO and the M&O contractor were directed to conduct a self assessment, which the SPRPMO completed in the fourth quarter of 1991 and the M&O contractor completed in the first quarter of 1992.

The DOE Order 5400.1, "General Environmental Protection Program," establishes environmental program requirements in effect at DOE operations. These environmental requirements fall into three categories: (1) those imposed by Federal statutes, regulations, and permitting authorities; (2) those imposed by state and local statutes, regulations, and permitting authorities applicable to DOE; and (3) those imposed by DOE directives. This compliance summary section addresses the requirements that are essential for SPR environmental compliance.

Several Federal, state, and local agencies are responsible for enforcing environmental regulations at the SPR. The principal regulatory agencies are the Environmental Protection Agency (EPA) Region VI, the Louisiana Department of Environmental Quality (LDEQ), the Railroad Commission of Texas (RCT), The Army Corps of Engineers (COE), and the Texas Water Commission (TWC). These agencies issue permits, review compliance reports, inspect facilities and operations, and oversee compliance with applicable regulations.

EPA develops, promulgates, and enforces environmental protection regulations and technology-based standards as directed by Federal law. In some instances, EPA has delegated regulatory authority to state agencies when state environmental programs meet or exceed EPA's requirements. Where regulatory authority is not delegated, EPA Region VI is responsible for reviewing and evaluating compliance with the EPA regulations.

2.2 COMPLIANCE STATUS FOR CALENDAR YEAR 1991

The SPR is regulated primarily under the jurisdiction of the Clean Water Act. The SPR sites have a total of 73 wastewater and stormwater discharge monitoring stations. The SPR also operates under jurisdiction of the Clean Air Act and the Safe Drinking Water Act. Site activities are conducted in accordance with requirements of Section 105 (National Contingency Plan) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). The SPR sites are either Conditionally Exempt Small Quantity Generators (CESQG) in Texas, or Small Quantity Generators (SQG) in Louisiana. They do not store or process hazardous wastes, and therefore do not have RCRA treatment, storage and disposal (TSD) permits. Each site has an EPA generator number which is used to track off-site manifesting of hazardous waste. There are no CERCLA removal or remedial action activities at any SPR site. No polychlorinated biphenyls (PCBs) or friable asbestos is stored or used at SPR sites. The following sections highlight compliance actions at the seven SPR sites by environmental statutes.

Clean Water Act (CWA)

In 1991, the seven SPR sites experienced a reportable total of six oil spills and seven brine spills in quantities greater than the one barrel (42 gallons). Spills in lesser quantities are generally not reported to any agency. All spills were immediately cleaned up and no long term impacts were observed. The SPR sites

each have a "Spill Prevention, Control and Countermeasures Plan" which addresses prevention and containment of oil spills. Five of the seven SPR Spill Prevention, Control, and Countermeasures Plans were revised and updated. The two remaining will be completed in 1992.

Thirty four National Pollutant Discharge Elimination System (NPDES) permit noncompliances occurred out of a total of 17,698 analyses performed in 1991. These noncompliances involved permit exceedances at the brine discharge, sewage treatment plant and stormwater outfalls, or were caused by sampling error, mechanical failures, and operator error. Noncompliances were of short duration and immediately resolved, causing no adverse environmental impact.

Clean Air Act (CAA)

Quarterly sampling of all valves and pump seals, whether or not in service, is now performed at Big Hill and Bryan Mound as required by the Texas Air Control Board (TACB). Previous monitoring included only those valves and pump seals in current use. TACB instructed the SPR to monitor all valves and pump seals. Annual inspections of secondary seals for floating roof storage tanks and reporting of other emission sources continues to be accomplished at all sites.

In August, 1990, the Louisiana Department of Environmental Quality (LDEQ) issued a Form Order to the SPR's St. James Terminal, and 73 industrial sites around the Baton Rouge, Louisiana area, permitted to emit 100 tons per year (tpy), or more of nitrous oxide or reactive hydrocarbons. The Order requires industry to develop maximum achievable control technology (MACT) to reduce emissions of volatile organic compounds (VOCs). The St. James Terminal is the only SPR site that requires MACT due to its location in Louisiana and potentially high emissions (>100 tpy) during drawdown and subsequent refill based on national emergency. In

August, 1990, DOE requested a hearing with LDEQ to show that MACT should not apply to this facility because emissions exceeding 100 tpy occur infrequently only during SPR drawdown. The hearing has not been scheduled to this date. In the interim, the SPR is updating air permit application at St. James (LA) and Big Hill (TX) to reflect process changes and revised calculation factors affecting emissions. All air permits will be reviewed for accuracy during 1992.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

The SPR has not conducted emergency response activities pursuant to this act. Reporting requirements under the Superfund Amendments and Reauthorization Act (SARA) (Title III, Tier II) do apply and were completed. The 1991 SARA Title III report was distributed, as required, by March 1, 1992. DOE Order 5480.14 required all DOE-owned sites to evaluate compliance with CERCLA. DOE Phase I & II reports (similar to CERCLA's Preliminary Assessment and Site Investigation process) were completed in 1986 and 1987 respectively. The reports assessed each site for the potential presence of inactive hazardous waste sites, and recommended no further action under CERCLA. The DOE Phase I & II reports were submitted to EPA, resulting in St. James Terminal, Sulphur Mines, and Bryan Mound sites being listed under Federal Facility Docket. The SPR has coordinated with the EPA this period and relisted all SPR sites as No Further Remedial Action Plan sites. All SPR sites are classified as generators (small quantity or conditionally exempt small quantity) and have never operated hazardous waste treatment, storage, or disposal facilities on or before November 19, 1980. No hazardous material releases have occurred.

Safe Drinking Water Act (SDWA)

The SPR oil storage caverns and brine disposal wells are regulated by the SDWA. The SPR operates 25 salt water disposal wells in

Louisiana. The Louisiana Department of Natural Resources (LDNR) issued a total of four Notices of Violation (NOVs) in 1991 regarding the saltwater disposal wells permitted in Louisiana. Three of the NOVs were for wells which failed routine integrity tests and corrective work was therefore required. The fourth NOV was a request for a duplicate copy of a 1988 report which the state lost or misplaced and was addressed by forwarding a second copy.

The West Hackberry facility negotiated a corrective action plan (CAP) for a leaking brine pond with LDEQ. The CAP was completed in February, 1992, with quarterly monitoring reports being submitted to the state.

Bryan Mound, St. James, and West Hackberry are on local municipal water supply. West Hackberry completed site piping modifications, similar to other sites with municipal water supplies, to prevent the backflow of water into the local water system. Bayou Choctaw, Sulphur Mines, and Weeks Island have water wells for nonpotable use and bottled drinking water. Big Hill has its own non-community, non-transient water supply and in March 1990 received Texas Department of Health (TDH) approval to operate, but continues to require bottled water in the interim until the wells are fully operational. The SPR and TDH are currently coordinating new sampling and reporting requirements for the Big Hill system.

Expanded baseline ground water surveillance is planned for 1992 at all SPR sites. Additional ground water monitoring wells will be installed where brine (saltwater) contamination is suspected in accordance with the ground water management and inspection program plan.

Resource Conservation and Recovery Act (RCRA)

In 1991, the SPR manifested hazardous waste from all SPR sites for offsite treatment/disposal. The wastes consisted primarily of

spent paint solvent, paint still bottoms, solvent contaminated oils, out-of-date chemicals, and aerosol cans. The SPR submitted notification forms of regulated waste activity to the EPA for all SPR sites. In 1991, accumulated monthly waste volumes exceeded the SQG & CESQG generator threshold a total of five times at the Bryan Mound, St. James, West Hackberry, and Weeks Island SPR sites. However, the SPR is operating under existing permits, and has coordinated actions to correct the exceedances with appropriate regulatory authorities.

The underground storage tanks (UST) at the SPR sites contain diesel or gasoline fuels. They are all registered under the UST program as required. Most USTs are less than 10 years old, and therefore monitoring and testing will not be required until December, 1992. However a recent review has indicated that two USTs are not in compliance with in-line leak detection which was required by December 1990. The two USTs indicated require leak detection on the gasoline and diesel dispenser lines required by the design having internal submerged pumps which pressurize these dispenser lines. This design is unique to these two Big Hill tanks. Automatic leak detection systems, developed specifically for this application will be installed by Texas certified tank technicians. Corrective action will be completed in 1992. The actions to be taken have been coordinated with appropriate regulatory authorities.

Toxic Substances Control Act (TSCA)

PCB's and friable asbestos are not stored or used at SPR sites. All nonfriable asbestos (gaskets, insulation) is disposed in accordance with applicable regulations as solid waste to local municipal landfills. Tests have indicated that the limited asbestos present on the SPR is nonfriable. All liquid-filled electrical equipment used on the SPR is PCB free.

National Environmental Policy Act (NEPA)

The SPR is preparing an Environmental Impact Statement, and prepared and submitted two Environmental Assessments, (EAs) in 1991. The Environmental Impact Statement for the expansion of the SPR to a 1 billion barrel reserve, will not be complete until late 1992. Scoping meetings for this project were held in early 1991. The two Environmental Assessments were for the brineline replacement and diffuser relocation project at Bryan Mound and a recovery equipment storage warehouse at the Elmwood Industrial Park near Project Management Office (PMO) headquarters. A Finding of No Significant Impact was issued on January 31, 1992 for the warehouse project, and the Bryan Mound brineline replacement project is still being assessed by the Program Office.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

All pesticides and herbicides were used in accordance with manufacturers recommendations. Restricted use pesticides were applied by licensed commercial applicators.

Endangered Species Act (ESA)

The SPR coordinated ESA requirements with the US Fish & Wildlife Service and other appropriate state agencies in conjunction with the Bryan Mound brineline replacement project Environmental Assessment. There were no ESA concerns expressed.

National Historic Preservation Act (NHPA)

NHPA related activities were coordinated with appropriate State Historical Preservation Offices during NEPA activities. Onshore and offshore historical site surveys were conducted in conjunction with the Bryan Mound brineline Environmental Assessment and found no historical or cultural sites.

Oil Pollution Act (OPA) of 1990

The regulations regarding the OPA have not yet been promulgated, therefore no guidelines exist for its implementation. However the

SPR is actively involved in assuring prevention of oil pollution in its routine activities.

Executive Order 11988, "Floodplain Management" and Executive Order 11990, "Protection of Wetlands."

A Floodplain/Wetland assessment was conducted as part of the Bryan Mound brine pipeline Environmental Assessment. No other activity involved either order.

Louisiana Administrative Code, Title 33 (LAC:33)

The State of Louisiana enacted a requirement to survey oil and gas facilities for the presence of naturally occurring radioactive material (NORM). Procurement action to conduct the survey was initiated in 1990. Actual surveys were performed in February 1991. In addition to the Louisiana sites, the Texas sites and the commercial facility in Houston storing SPR piping were also surveyed even though the state of Texas does not regulate NORM. Surveys indicated that NORM readings did not exceed action levels beyond background levels at any Texas or SPR site.

2.3 CURRENT ISSUES AND ACTIONS (1991)

During 1991, the SPR has maintained a status of low risk to the environment. NOVs have declined significantly from 10 (all administrative) in 1990 to four (one administrative, and three disposal well structural deficiencies) in 1991. All NOVs have been resolved. Spills and releases have also declined significantly from 27 in 1990 to 13 in 1991. No long-term adverse environmental impact resulted from any spill or release.

CAA

Due to changes in the CAA, the existing air permits at all SPR sites will be reevaluated to incorporate new requirements. Completion of the review, with revisions as necessary, is expected in 1992.

CWA

Inspections in 1991 by TWC and LDEQ indicated some administrative oversights and deficiencies primarily with sample handling and record keeping procedures. All the agency's recommendations have been addressed, and resolved.

SDWA

To preclude recordkeeping violations (see Section 2.2, Safe Drinking Water Act) of work performed on SPR disposal wells, a quarterly "look ahead" schedule to provide visibility and highlight upcoming requirements has been implemented.

Findings from the brine pond ground water studies at West Hackberry and Bryan Mound indicate that ground water contamination from leaking brine ponds or buried piping has occurred at both sites. Additional monitoring and recovery wells to remove brine contamination from ground water were installed at West Hackberry. A corrective action plan to further identify, control, and/or remediate brine contamination at Bryan Mound will be developed in 1992. Affected ground waters at both sites are naturally brackish and not suited for domestic or agricultural use and therefore will not be a significant factor in determining future action.

NEPA

The management and operating (M&O) contractor's operating procedure for NEPA compliance, 13OP-8, was prepared December, 1991, to facilitate consistency with NEPA requirements and assist in implementing a more formal program.

Routine environmental reports and notifications have been submitted as required by applicable codes and permits. Seven applications to renew NPDES permits controlling discharges from SPR sites are currently in abeyance by the EPA until the new M&O contractor is in place, which is scheduled for April, 1993. These and all operating permits are current, and the SPR is under no

regulatory compliance orders. There are no unresolved or open NOVs at the SPR. There are no outstanding lawsuits involving environmental compliance at the SPR.

All stored crude oil at the Sulphur Mines site was transferred to Big Hill and West Hackberry. The site was officially decommissioned in the first quarter of 1992, and is awaiting sale or transfer. Information required by 40 CFR 373 was provided, indicating that no known hazardous waste disposal areas exist on site.

On June 28, 1991, the Deputy Assistant Secretary for Strategic Petroleum Reserve (SPR) directed that all operations at the Bryan Mound site cease, except for operations necessary to ensure the storage integrity of the site's current crude oil inventory. A DOE Type A investigation was conducted as a result of the numerous safety and operations incidents that had taken place at the site over the past year. The primary cause was less than adequate procedures as required by DOE Order 5480.19 to control operational processes. The site has been shut down since April 1, 1991, and is scheduled for startup in July, 1992 pending headquarter's approval.

The issuance of the Louisiana Form Order (to provide administrative controls to reduce emissions during ozone events) to state air permit holders who release 100 tpy VOCs or more, has caused the SPR to reevaluate their existing air permit, and update as necessary. This activity will be undertaken in 1992.

2.4 SUMMARY OF PERMITS (1991)

Permits currently in effect include seven NPDES permits, seven CAA permits, 45 Corps of Engineers (COE) wetlands permits (Section 404 of CWA), and over 100 oilfield pit, underground injection well,

and mining permits. In addition, a number of corresponding state discharge and other state and local permits are in effect.

2.5 COMPLIANCE STATUS FOR JANUARY 1 THROUGH APRIL 1, 1992

CWA

During this period no oil spills, one brine release, and fifteen NPDES noncompliances occurred, which were immediately corrected when discovered. The brine release occurred at Bryan Mound and resulted from seepage observed from the onsite brine pond. An equivalence of two barrels of brine were released and the leak was reported verbally to DOE and the state. Written follow up was not required because the spill did not exceed the five barrel threshold volume.

Twelve of the NPDES noncompliances were due to procedural errors (no sample taken or analysis performed), and the remaining three were minor excursions over the permit limit. Of the 15 NPDES noncompliances, eight procedural and one excursion occurred at Bryan Mound, three procedural and two excursions occurred at Big Hill, and one procedural noncompliance occurred at St. James Terminal. No adverse environmental impacts occurred as a result of the brine release or the NPDES noncompliances observed to date.

The Bayou Choctaw Spill Prevention, Control, and Countermeasures Plan was revised and updated this period. The remaining SPCC plan for West Hackberry will be revised later in 1992.

CAA

All monitoring and reporting has continued without deficiencies in accordance with the permit requirements.

The SPR has completed the emissions evaluation at the St. James Terminal to determine a course of action in response to the LDEQ's request to evaluate the need for MACT. Activities are underway to

revise the St. James air permit to reflect "actual emissions" during standby operation and to exempt St. James from those occurrences (Federally mandated drawdown and subsequent refill) when VOCs would exceed levels requiring MACT. If exemption is not provided, use of a vapor recovery unit during drawdown and refill will be evaluated.

SDWA

Results of the ground water monitoring study performed for West Hackberry were presented to LDEQ and the terms and conditions of a ground water CAP were finalized. Implementation of the CAP began in 1991 and culminated in the use of ground water recovery systems in the first quarter of 1992. This effort is ongoing with quarterly monitoring reports being submitted to LDEQ.

In-line leak detection will be installed on the two USTs not in compliance with UST requirements later in 1992. This action resulted from the SPR's finding and not as a result of any regulatory agency activity.

SARA

All 1991 Title III, Tier II reports were distributed prior to March 1, 1992, as required, to the various state and local agencies and local fire departments.

NEPA

Twenty-five projects were submitted for NEPA review action in the first quarter of 1992.

During 1991 there has been regulatory coordination in regards to CERCLA, ESA, NHPA, and Executive Orders 11988 and 11990. No activity has been required relative to TSCA and FIFRA.

2.6 CURRENT ISSUES AND ACTIONS (JANUARY 1 THROUGH APRIL 1, 1992)

For the first quarter of 1992 the major action on the SPR has been responding to the DOE-sponsored Tiger Team Assessment (TTA). The TTA reviewed many aspects of SPR operations, including Environmental, Safety, Health, Management, and Self Assessment areas.

During this period no new environmental activities, outside of the TTA, were initiated. Work continued on the ground water corrective action plan at West Hackberry, preparing the laboratory sampling and analysis plan, and updating the permits manual. Preliminary site visits were made by DOE and BPS personnel in preparation for the upcoming permitting of stormwater requirements.

Routine compliance reporting (monthly and quarterly NPDES DMRs) and annual waste inventory and underground injection reports were prepared and delivered to appropriate agencies during this period.

The SPR Program Office continues to process the Bryan Mound Environmental Assessment submitted during the fourth quarter of 1991.

2.7 SUMMARY OF PERMITS (JANUARY 1 THROUGH APRIL 1, 1992).

There has been no change in the SPR's permit status during this quarter.

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3. ENVIRONMENTAL PROGRAM OVERVIEW

The environmental program is implemented by a prime contractor for the SPR on behalf of the United States Department of Energy (DOE) (who holds the environmental permits). The environmental program is designed to support the SPR through tasks aimed at avoiding or minimizing adverse environmental effects from the SPR on surrounding lands and water bodies.

The monitoring and inspection program was originally developed under guidance of the SPR Programmatic Environmental Action Report, Site Environmental Action Reports, and DOE Orders. This program includes monitoring permitted National Pollutant Discharge Elimination System (NPDES) outfalls and air emissions, conducting other required Federal and state inspections, and regular sampling and analysis of site-associated surface and ground water quality. This makes possible the assessment of environmental impacts and early detection of water quality degradation that may occur from SPR operations.

The results of the individual program areas such as air quality monitoring and reporting, NPDES compliance, water quality monitoring, and ground water monitoring, for 1991 are discussed in sections 5 and 6.

3.1 ASSOCIATED PLANS AND PROCEDURES

Associated plans and procedures developed to support the SPR environmental program include group-specific Spill Contingency Plans with spill reporting procedures, site-specific Spill Prevention, Control, and Countermeasures Plans, the Environmental Programs and Procedures Manual that includes a Solid Waste Management Plan, an Underground Injection Control Plan, and a Fugitive Emissions Monitoring Plan. Plans and procedures for ground water protection, pollution prevention awareness, and waste minimization were prepared in 1990, and issued in early 1991. Compliance with Federal, state, and local laws, regulations, and permits has been accomplished in part by implementation of these plans and procedures.

3.2 TRAINING

Site Environmental and Emergency Response Team (ERT) personnel have received training in environmental plans and procedures. Site management personnel are knowledgeable of environmental procedures, spill reporting procedures, the group-specific Spill Contingency Plans, the site-specific Spill Prevention, Control, and Countermeasures Plans, and compliance awareness. Compliance awareness training is conducted by the individual site environmental specialists at each of the SPR sites. During this training, site personnel learn about applicable regulatory requirements. Several sessions of an environmental awareness course were provided to DOE and contractor management and staff in 1991.

ERT personnel from all sites participate in annual spill response refresher training by the Texas A & M University, Engineering Extension Service. Onsite training is also provided in spill cleanup and control. Site response personnel are trained to rapidly and effectively contain and cleanup oil, brine, and hazardous substance spills under the special circumstances unique to each SPR site.

3.3 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.

3.3.1 Spill Reports

The spill contingency plans include procedures for reporting spills to the SPR contractor, 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 (e.g., wetland or water body). Any spill considered significant at the site is first verbally reported

to site management and then to the SPR contractor management in New Orleans and the onsite DOE representative. These procedures contained in contractor operating procedure 22OP-21 "Reporting of Spills," have been simplified and condensed to a credit card-like document for attachment to identification badges and to a laminated placard for handy desk reference. Verbal notification to the appropriate regulatory agencies follows when necessary. Final written reports from the site are submitted after cleanup, unless otherwise directed by the DOE or appropriate regulatory agency.

3.3.2 Discharge Monitoring Reports

Wastewater discharges from SPR sites are authorized by the Environmental Protection Agency (EPA) through the NPDES Program. Depending on site specific permit requirements, discharge sample analyses are reported to the state and EPA monthly (Big Hill, Bryan Mound, and West Hackberry), and quarterly (Bayou Choctaw, Saint James, Sulphur Mines, and Weeks Island). Included in the report is an explanation of the cause and actions taken to correct any noncompliance or bypass.

3.3.3 Other Reports

The SPR contractor provides several other reports to or on behalf of DOE. These reports include:

a. Fugitive Air Emissions for Bryan Mound (quarterly);
b. Emission Inventory Questionnaire Status update for St. James Terminal, Sulphur Mines, and Weeks Island (annually);
c. Air Quality Construction Status Report for West Hackberry and Bayou Choctaw (semi-annually);
d. Permit Tracking System review and update (annually and quarterly);
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 Big Hill, Bryan Mound, and West Hackberry (monthly)
i. Quarterly Environmental Compliance Report (SEN-7a) (recently discontinued)
j. Performance Indicator Program (quarterly)
k. OMB Circular A-106 Environmental Project Plan (semi-annually)
l. Environmental Compliance Issue Coordination DOE Order 5400.2A (annual) (to be included into annual site environmental report)
m. Environmental Protection and Implementation Plan DOE Order 5400.1 (annual revision)
n. Annual Monitoring Report (RCT:H-10)
o. Plug and Abandon Report (as needed)
p. Work Resume Report (LDNR as needed)

3.4 OIL SPILLS: RECAPITULATION

In 1991, the total amount of oil moved (received and transferred internally or sold) was approximately 8.5 million m^3 (52.99 MMB). The total number of crude oil spills, total volume spilled, and the percent volume spilled of total volume moved are shown below (Table 3-1) for each year from 1982 through 1991.

The oil spills involving quantities in excess of 0.16 m^3 (one barrel (bbl)) that occurred during 1991, both contained and uncontained, are presented in Table 3-2. Oil spills in excess of one barrel are comparable to 1985 to 1988 levels. Five of the spills were small, and the sixth was medium (200 bbls), but contained on the wellpad. No spills of oil occurred during the period July to December (1991).

Each of the six spills experienced during 1991 had different causative factors. These factors varied from sump overflow during excessively heavy rainfall to failure of gaskets during

pressurization of the oil lines. No trend is readily apparent from this year's data.

Table 3-1. Number of Crude Oil Spills

Year	Total Spills	Volume Spilled m^3 (barrels)	Percent Spilled of Total Throughput
1982	24	847.0 (5,328)	0.00704
1983	21	380.9 (2,396)	0.00281
1984	13	134.8 (848)	0.00119
1985	7	85.4 (537)	0.00122
1986	5	1232.5 (7,753)	0.01041
1987	5	2.5 (16)	0.00002
1988	6	8.8 (55)	0.00001
1989	11	136.4 (858)	0.00004
1990	14	74.8 (467)	0.00003
1991	6	37.9 (237)	0.0004

Table 3-2. 1991 Oil Spills

DATE	LOCATION	AMOUNT	CAUSE/CORRECTIVE ACTION
04/05/91	BM	0.64 m^3 (4 bbls)	Pressure surge caused a leak in the 30" diameter oil pipeline at the meter skid. The leak occurred at a flange, and was repaired.
04/15/91	WH	0.64 m^3 (4 bbls)	In performing a pressure test at the HPP, approximately 4 barrels of crude oil leaked onto the pad from a valve while filling the pump and an associated valve with water.
04/30/91	BH	32 m^3 (200 bbls)	The blow out preventors at Cavern 111 failed, allowing the crude oil to spill onto the cavern pad.
05/08/91	WH	0.2 m^3 (1.25 bbls)	Heavy rainfall backing up onto the HPP caused the crude oil in the HPP sump to overflow and spill into the retention pond.

Table 3-2. 1991 Oil Spills cont.

DATE	LOCATION	AMOUNT	CAUSE/CORRECTIVE ACTION
06/14/91	BH	0.48 m^3 (3 bbls)	A mixture of brine and oil was lost onto the cavern pad at cavern 109. These materials were vacuumed and placed into a frac tank. While pumping the brine from the anhydrite pond from the frac tank, the interface was allowed to get too low and oil was pumped into the anhydrite pond.
06/26/91	WH	2.1 m^3 (13 bbls)	A relief valve on cavern 6 activated and overflowed a collection drum spilling onto the ground inside the wellpad.

3.5 BRINE SPILLS: RECAPITULATION

The SPR disposed of 28.8 million m^3 (179.8 MMB) of brine (mostly saturated sodium chloride solution, some discharges were of lower salinities than normally attributed to brine) during 1991. Approximately 91.5% of the brine was disposed in the Gulf of Mexico via the Big Hill (85.4% of the total), and West Hackberry (6.1% of the total) brine disposal pipelines. The remainder was disposed in saline aquifers via injection wells at the Bayou Choctaw (8.0% of the total) and West Hackberry (0.4% of the total) sites. In 1991, no disposal of saltwater occurred at either the Bryan Mound or Sulphur Mines sites and less than 0.1% of the total was disposed at permitted offsite disposal wells.

The total number of spills, total volume spilled, and percent volume spilled of total volume disposed are shown in Table 3-3 for each year from 1982.

The brine spills involving quantities in excess of 0.16 m^3 (one bbl), both contained and uncontained, during 1991 are discussed in Table 3-4.

Corrosion/erosion has been the leading causal factor for brine spills over the past few years. Other types of failures (gasket/flange/other equipment) have contributed somewhat. The second major factor is operator error. Three of the seven spills are attributable to operator error, the fourth was a pipe ram not seating properly, and an additional spill resulted from leakage from a flange. The remaining two spills were attributable to leakage due to corrosion/erosion.

In addition, two of the seven spills accounted for over 98% of the total volume lost during 1991. One of these spills resulted from operator error, and the other was due to corrosion/erosion. Excluding brineline failures, the volumes spilled per year remained relatively constant, probably reflective of quick site response.

Table 3-3. Number of Brine Spills

Year	Total Spills	Volume Spilled m^3 (barrels)		Percent Spilled of Total Disposed
1982	43	443.8	(2,792)	0.0005
1983	44	259.4	(1,632)	0.0002
1984	17	314.0	(1,975)	0.0003
1985	16	96,494.8	(607,000)	0.1308
1986	7	275.6	(1,734)	0.0017
1987	22	96.5	(608)	0.0003
1988	12	93.8	(586)	0.0001
1989	17	131,231.6	(825,512)	0.1395
1990	12	11,944.3	(74,650)	0.0170
1991	7	1,156.8	(7,230)	0.004

No significant long term adverse environmental impact was observed from any SPR brine spills as evidenced by subsequent surveys and water quality monitoring.

Table 3-4. 1991 Brine Spills

DATE	LOCATION	AMOUNT	CAUSE/CORRECTIVE ACTION
1/14/91	WH	1.9 m^3 (12 bbls)	An improper procedure was employed by site personnel in cutting a portion of a brine-containing pipeline. Brine was released into a wellpad ditch, then recovered.
6/14/91	BH	0.3 m^3 (2 bbls)	The spilled brine was released from the hydril through faulty pipe rams, while working over cavern 109. The brine was contained on the wellpad.
6/24/91	BM	960 m^3 (6000 bbls)	By opening the incorrect valve on the 30 inch brineline, south of cavern 104, 6000 barrels of brine were lost while bleeding pressure off of cavern 104. The brine spilled into a pond onsite.
8/13/91	BC	17.1 m^3 (107 bbls)	A capped but not closed ball-valve allowed 107 barrels of brine to be released onto the saltwater disposal well pad No. 1. The pad was flushed with raw water and then vacuumed.
9/7/91	WH	176 m^3 (1100 bbls)	A leak developed in the 36" brine disposal line beneath the NE sacrificial pond. Once observed, pumps were placed to transfer the brine from the sacrifi- cial pond to the brine pond. Environ- mental monitoring and repairs were implemented.
9/24/91	WH	0.3 m^3 (2 bbls)	A leaking valve flange at the High Pressure Pump Pad released approximately 2 barrels of brine during pressure-up for a cavern integrity test. The valve flange was not sufficiently tightened by contractor prior to the test.
10/14/91	BC	1.1 m^3 (7 bbls)	A connection (tee) in brine line BC-24-BR -1529B leaked the brine south of valve 20 f 15. The leak and contaminated waters were contained, vacuumed, and the area restored.

3.6 WASTEWATER DISCHARGE COMPLIANCE

In 1991, a total of 16,698 analyses were performed to monitor wastewater discharge quality from the SPR in accordance with NPDES

and corresponding state permits. Although 34 noncompliances were reported (Tables 5-2 through 5-8), the SPR was in compliance with permit requirements for approximately 99.8% of the analyses performed. During the calendar year (CY) 1991, seventeen or (50%) of the permit noncompliances experienced on the project were due to sampling or sampling related phenomena. These sampling related noncompliances were almost twice as numerous as the permit [parameter] excursions or exceedances. Combining these two categories of noncompliant events covers 85% of the noncompliances experienced in 1991.

In overview, 17 (or 50%) of the noncompliances were related to sampling, sample handling, or sample data management; 12 (or 35%) of the noncompliances represented limits being exceeded; three (or 9%) were bypasses of treatment devices and two (or 6%) were those events related to depleting oxygen in a brine flow to the Gulf (brineline operations).

Corrective actions implemented to mitigate noncompliance recurrence included developing or modifying applicable procedures, retraining and certifying personnel, initiating special studies, and repairing faulty equipment.

3.7 PIPELINES

The SPR owns 325 miles of pipelines for transporting either crude oil, raw water, or brine. The crude oil lines tie each site into a terminal for distribution during a drawdown to refineries by pipeline, tanker, or barges. They also serve to fill the SPR with crude oil.

The raw water lines bring water to the sites for solution mining to create the caverns in the salt domes and during drawdown to displace the crude oil. The brine disposal pipelines either dispose of brine in saline underground aquifers or offshore in the Gulf of Mexico as allowed by permit. Brine discharges occur during solution mining, fill-refill, and to relieve pressures from cavern creep.

The pipelines are routinely inspected by designated pipeline crews, periodic overflights, coupon monitoring, pigging, and various testing including integrity flow tests and ultrasonic testing.

3.8 WASTE MINIMIZATION PROGRAM

A waste minimization program was created, documented, and implemented to reduce the generation of all wastes including hazardous waste. The SPR has introduced a shop rag service, is eliminating the use of styrofoam cups, and is substituting less hazardous materials in the workplace as some of its methods to minimize waste. Reviews of purchase requisitions for chemical products are used to reduce waste (product substitution, smaller quantities) generated. An aerosol can puncturing method (and equipment) was introduced to minimize hazardous waste from aerosols. Utilization of distillation units recycle solvents for reuse. Office paper recycling was implemented in NOLA. Used oil and antifreeze recycling was begun at each of the SPR sites, and efforts continue to search for new methods of waste minimization.

3.9 SPECIAL ENVIRONMENTAL ACTIVITIES

Brief examples of SPR environmental activities implemented during CY 1991 are presented below. In overview, 1991 included a series of audits, drills, and self-assessment activities focused on the environmental aspects of SPR operations. The result was positive, particularly with respect given to the upcoming Tiger Team audit scheduled for the first quarter of 1992.

Throughout the year BPS conducts environmental audits of SPR site operations. The objective of these audits are to establish a yearly snapshot of the status of operational readiness throughout the SPR infrastructure relative to Federal and state regulations, DOE Orders, and pertinent procedures. Later in the year, pre-Tiger Team "self-assessments" were performed utilizing an outside

contractor to provide a baseline prior to the 1992 Tiger Team review. The pre-Tiger Team audits included visits to several sites and focused on environmental, safety and health aspects of SPR operations. Conduct of Operations training was held on the SPR sites, providing excellent practice techniques for the Tiger Team assessment.

Throughout the year, a general focus was placed on the analytical laboratory functions and capabilities. During the year, an environmental programs manager was named, five new personnel were added, an analytical programs manager was selected, new laboratory equipment was purchased and installed, and new procedures were devised. In addition, various site laboratories were inspected by LDEQ (WH, BC, and WI) and a general environmental audit was performed by DOE/Oak Ridge representatives. Also, a major portion of the pre-Tiger Team activities were related to the conduct of operations of the SPR environmental laboratories.

Ground water activities received substantial attention during 1991. The Geraghty & Miller reports for WH and BM were received early in the year and preparations for future studies at the remaining SPR sites evolved. In addition, a ground water recovery program was developed and begun during the year at the West Hackberry brine pond. This work was guided by the Geraghty and Miller studies and as negotiated with LDEQ. The overall action involves ground water withdrawal to assert hydraulic control of the existing plume and contaminant removal by placing the brine contaminated water back into the repaired brine pond for disposal. In addition, work was expended on finalizing a ground water sampling and analysis plan and updating the Ground water Program Plan.

Waste handling and programmatic waste management issues also received special effort during 1991. An approved products list for the SPR was initiated through Environmental Control in order

to effect waste minimization and hazardous waste generation reduction. Recycling efforts for waste oil and office paper were initiated and efforts were made to incorporate the use of recycled products where possible.

Emergency Response Exercises (EMEX-7) were conducted at Bryan Mound and Big Hill Sites and which also included state and local agencies, as well as the New Orleans emergency operations office. The effort was well received by local authorities and was considered an all around success for the SPR.

The Environmental Advisory Committee, whose purpose is to supplement existing BPS environmental and safety efforts by providing impartial assessments and advice to the operating management, public, and media relative to SPR management, programs, and policies, held its quarterly meetings in 1991.

There were several recommendations from the Environmental Advisory Committee during 1991. One was that while the West Hackberry brineline is being repaired and/or replaced, it should be moved east 1,000 feet onto an existing spoil bank to minimize impact on oyster beds. Another recommendation was that the Environmental Advisory Committee should have some input into the site selection process for the SPR expansion. A third recommendation was that communications between SPR facilities and neighboring operators needs to be improved.

4. ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

There are no radioactive process effluents from any SPR facility. The only radioactive materials at any SPR facility are sealed sources in certain field instruments.

4.1 SEALED SOURCES

A total of 104 nuclear density gauges (SGH Model Nos. 5190, 5191, and 5202) are located on pipelines within the Bayou Choctaw, West Hackberry, Sulphur Mines, and Bryan Mound sites. The gauges are used for monitoring fluid density changes (oil versus brine) in pipelines. Each gauge unit contains between 100 and 4000 millicuries (mCi) of cesium 137. Gauge wipe tests are performed every three years as required by the general license. The DOE is a general licensee under the manufacturer, Texas Nuclear. No radiation leakage has been detected to date.

A Princeton Gamma Tech Model 100 sulfur analyzer, used in the St. James laboratory for analyzing sulfur concentrations in oil samples, was excessed in June 1991, and is scheduled to be removed from the site in May 1992. A similar instrument was excessed at Bryan Mound in 1990. The radioisotope source for each analyzer was 50 mCi of iron 55. No radiation leakage from either analyzer has been detected from semiannual wipe tests.

4.2 NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)

In 1989, LA amended its radiation regulations to require a survey to determine the locations and contamination levels of NORM in the oil and gas industry. The M&O contractor has contracted for each of its sites to be surveyed, especially in the laydown yards where pipe is stored. It is believed that radioactive material becomes bound with the pipescale and pipewall coatings that result from oilfield drilling activity. A cursory inspection using a geiger counter was conducted. This preliminary inspection revealed no NORM present. The contracted survey, conducted at all SPR sites

and the commercial pipe yard where SPR piping is stored, was completed in early 1991. The results, no readings of elevated levels at any location, were submitted to the state as required. No future monitoring is anticipated.

5. ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

A primary goal of DOE and the SPR contractor is to ensure that all SPR activities are conducted in accordance with sound environmental practices and the environmental integrity of the SPR sites, and their respective surroundings, is maintained.

Effective environmental monitoring (separate from discharge permit compliance monitoring) provides a mechanism for assessing the impact of SPR activity on air, surface water, and ground water (section 6). Site monitoring programs were developed as management tools to provide the information necessary for limiting unwarranted environmental impacts, thus serving the public interest by ensuring environmentally sound operation of the SPR.

5.1 AIR QUALITY

During 1991, air emissions were monitored primarily through measurements and calculations from operating data. Volatile hydrocarbons from valves, pumps, seals, storage tanks, tankers, and brine ponds are the predominant air emissions from SPR facilities. They are monitored for permit compliance at Big Hill and Bryan Mound using an organic vapor analyzer. The quantity of hydrocarbon emissions increases at several sources (tanks and brine ponds) with increases in oil throughput. Less emissions occur during periods of static storage. Small amounts of hydrogen sulfide are released from some crude oils handled and stored by the SPR. Estimated emissions associated with the SPR were generally lower during 1989, 1990 and 1991 as compared to 1982 through 1988 due to the reduction in fill activity. Actual throughput was monitored at Bryan Mound only and is discussed in the Bryan Mound subsection. Dust emissions from most site roads have been mitigated through paving or application of dust control agents.

5.1.1 Bayou Choctaw

During 1991, Bayou Choctaw, located in a nonattainment area for ozone, operated in accordance with air quality regulatory requirements. Total emissions from the facility were calculated using method AP-42 (EPA, 1985) to be less than nine metric tons/year(10 tons/year) (a "nonsignificant facility" as noted in the air quality regulations for Louisiana). Nonsignificant facilities are exempt from vapor monitoring requirements. There were some minor configuration changes which would result in minimal additional air emissions during 1991. No air quality monitoring using actual monitoring equipment was required or conducted during 1991.

5.1.2 Big Hill

The Big Hill facility, located in a nonattainment area for ozone, operated in accordance with applicable air quality regulatory requirements and all conditions of the air quality permit. This included wetting plant roads with water and dust abatement chemicals to control fugitive dust emissions. Annual hydrocarbon emission monitoring as required by the permit began in 1990 when crude oil fill was initiated. This monitoring involves testing for fugitive VOC emissions from valves and pump seals on a quarterly basis. There was one valve in 1991 that was considered to be leaking and was fixed. No other repairs were needed based on this monitoring. The secondary tank seals for BHT-7, inspected annually in accordance with Federal and State regulations, were within required limits.

5.1.3 Bryan Mound

The Bryan Mound facility, located in a nonattainment area for ozone, operated in accordance with all air quality regulatory requirements throughout 1991. The ongoing fugitive emissions monitoring program, as required by the TACB, includes monitoring for fugitive VOC emissions from valves and seals on a quarterly basis using a VOC detector. The program also includes monthly calculations of emissions based on crude oil throughput for each storage tank. No leaks (greater than 10,000 ppm) of hydrocarbon vapors from valves or pump seals were detected during 1991. Hydrocarbon emissions from surge tanks were calculated at 0.097 metric tons (1.1 tons) during 1991, or 17% of the permitted limit (5.5 metric tons (6.1 tons) per year).

5.1.4 St. James Terminal

St. James Terminal, located in a nonattainment area for ozone, operated in accordance with all air quality permit and regulatory requirements during 1991. Hydrocarbon emissions for 1991 were well below the levels projected in the Emission Inventory Questionnaire (866 metric tons/year for loading operations and 541 metric tons/year for unloading operations) even though 6 million barrels of crude oil went through the facility during the 1991 Desert Storm sale. Estimated emissions for 1991 were 59 metric tons (65 tons). Secondary seal gap measurements were also taken and were within required limits. No air quality monitoring using actual monitoring equipment was required or conducted during 1991.

5.1.5 Sulphur Mines

Sulphur Mines operated in accordance with all air quality permit and regulatory requirements during 1991. No configurational or operational changes affecting emission rates occurred at Sulphur Mines. Hydrocarbon emissions, based on crude oil throughput, were well below levels cited in the Emissions Inventory Questionnaire (0.2 metric tons (440 pounds)/year for standby (static) mode of operation). No air quality monitoring using actual monitoring equipment was required or conducted during 1991. This SPR site is located in a nonattainment area for ozone. All stored crude oil was removed from the site in preparation for the March 1992 decommissioning.

5.1.6 Weeks Island

Weeks Island is one of two SPR sites in an attainment area for ozone. The site operated in accordance with all air quality permit and regulatory requirements during 1991. No significant configurational or operational changes affecting emission rates occurred at the facility. Hydrocarbon emissions, based on throughput, were well below levels shown in the Emissions Inventory Questionnaire (i.e., 0.2, 0.6, and 0.8 metric tons (440, 1320 and 1760 pounds) per year for filling, withdrawal and recirculation operations, respectively). Air quality monitoring using actual monitoring equipment was neither required nor conducted during 1991.

5.1.7 West Hackberry

West Hackberry, located in an ozone attainment area,operated in accordance with all air quality permit and regulatory requirements during 1991. Hydrocarbon emissions were well below the 50.4 metric tons (55.4 tons) permitted for filling operations. Air quality monitoring using actual monitoring equipment was neither required nor conducted during 1991. There were no construction or configurational changes which would have resulted in additional emissions during 1991.

5.2 SURFACE WATER QUALITY MONITORING

During 1991, the surface waters of the Bayou Choctaw, Bryan Mound, Sulphur Mines, and West Hackberry SPR sites were sampled and monitored for general water quality. This monitoring is separate from, and in addition to, the water discharge permit monitoring program and is not required by any Federal or state regulatory agency. Surface water quality monitoring was not conducted at St. James Terminal or Weeks Island because of the low potential to impact surface waters on these two sites. Table 5-1 identifies frequency of specific parameters measured at each SPR site. Variations in the data are discussed by site following the water quality monitoring discussions.

5.2.1 Bayou Choctaw

Samples collected once monthly at each monitoring station were used to monitor surface water quality. Specific monitoring stations are identified by letter in Figure 5-1. Parameters monitored in the Bayou Choctaw surface waters included pH, salinity, temperature, dissolved oxygen (DO), and oil and grease. A discussion of each parameter follows. Years without data are shown as blank in the following graphs.

5.2.1.1 Hydrogen Ion Activity (pH)

The hydrogen ion activity, or pH, remained essentially neutral (7.0) in most cases. The 1982 through 1991 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.

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Table 5-1
Physiochemical Parameters

PHYSICO-CHEMICAL PARAMETERS	SAMPLE IDENTIFICATION AND FREQUENCY BY SITE																	
	DAILY						WEEKLY			MONTHLY								QTR
	BC	BH	BM	SJ	SM	WM	BH	BM	BM	BC	BH	BM	SJ	SM	WI	WM		SJ
pH	15, 17-20 101 MPP SUB1 SUB2 SUB3	003	101-116 1,2 4,5 TX-001 002	001		001 6-9, 11 101-117 MPP SOT			001, 002 2,4, 6,7, MPP	001 002 A-F	001 002 004 A-G	001 A-J		A,B D-G	01A 01B 002	002 A-F 001 004		002 003
SALINITY		001	001			001 MPP			002	A-F	A-G	A-J		A,B D-G		A-F		
TEMP.		001	001			001				A-F	A-G	A-J		A,B D-G		A-F		
TOTAL DISSOLVED SOLIDS						001	001	001								A-F		
TOTAL SUSPENDED SOLIDS						001	001 002	001	004	001 002	004	002*			01B 002 003	002 A-F		002 003
DISSOLVED OXYGEN		001	001			001				A-F	A-G	A-J		A,B D-G	A-F			
BOD_5								001	004	001 002	004	002*			01B 002	002		002 003
COD			TX-001 1,2 4,5 101-116									A-J						
OIL & GREASE	15, 17-20 101 MPP SUB1 SUB2 SUB3	001 003	001 101-116 1,2 4,5 TX-001	001		001 6-9 11 101-117 MPP			2,4, 6,7, MPP						01A	004		
TOC		003		001		6-9 11 101-117 MPP SOT		001		A-F	A-G	A-J		A,B D-G	E	A-C E-F 004		
FECAL COLIFORM															01B 002	002		
RESIDUAL CHLORINE		004	TX-002															
FLOW	001 002 15, 17-20 101 MPP SUB1 SUB2 SUB3	001	TX-001, 001	001		001 MPP**	002 004**	TX-002*	001, 002, 2,4, 6,7, MPP			002*	002 003		01A 01B 002 003	002 004		

* Sampling performed twice per indicated period.
** Sampling performed 5 days/week.

MPP: High Pressure Pump Pad
SUB: Salt Water Disposal (Injection Well)
SOP: Slop Oil Tank

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.

BAYOU CHOCTAW

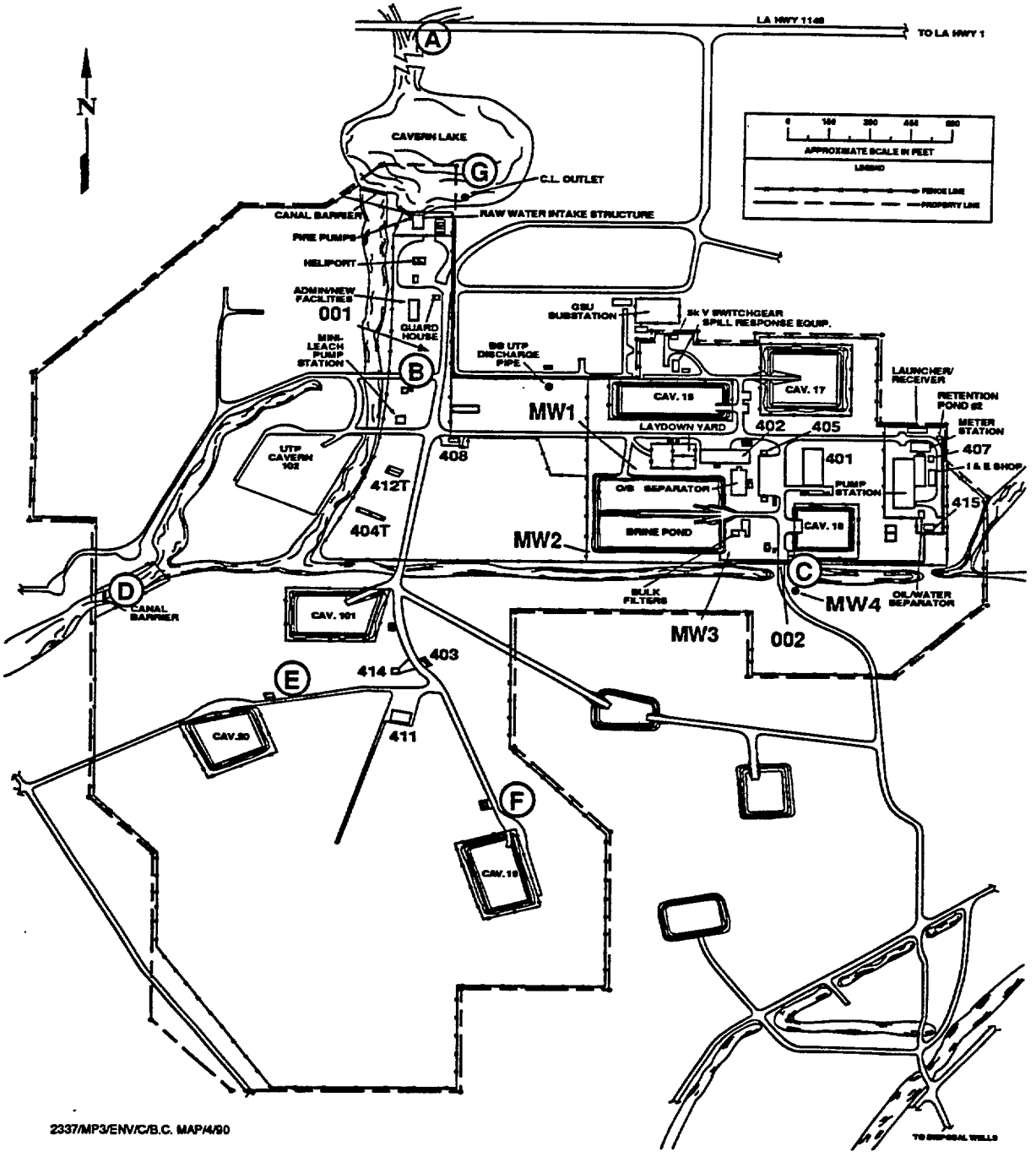


Figure 5-1

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

Discharge Monitoring Stations

001 Discharge from sewage treatment plant (administration building)

002 Discharge from sewage treatment plant (control building) stormwater discharges

Stormwater and pump flush from pump pads

Stormwater runoff from well pads 15, 17-20, and 101

Water Quality Monitoring Stations

A Canal north of Cavern Lake at perimeter road bridge

B North-South Canal at bridge to caverns 10, 11, and 13

C East-West Canal at Intersection of road to brine disposal wells

D East-West Canal at cavern 10

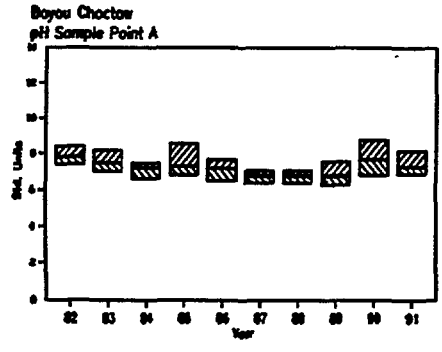
E Wetland Area near well pad 19

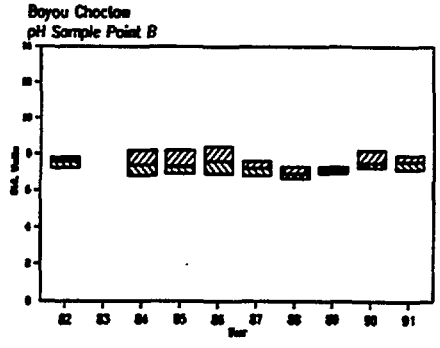
F Wetland Area near well pad 20

G Near Raw Water Intake (new station established 10/31/90)

Figure 5-1

(Sheet 2 of 2). Bayou Choctaw Environmental Monitoring Stations


Boyou Choctow
pH Sample Point A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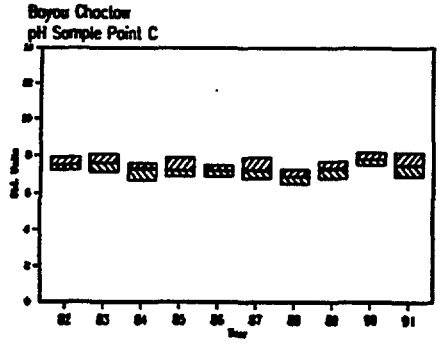
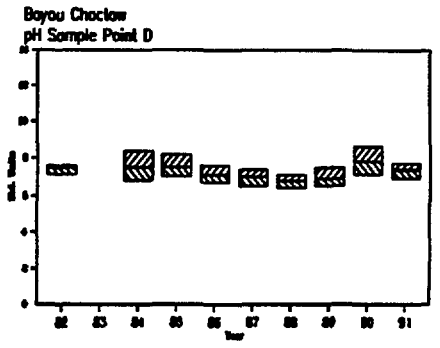
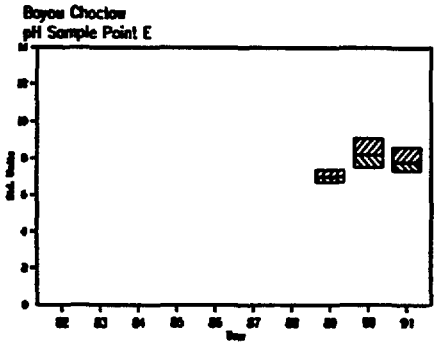
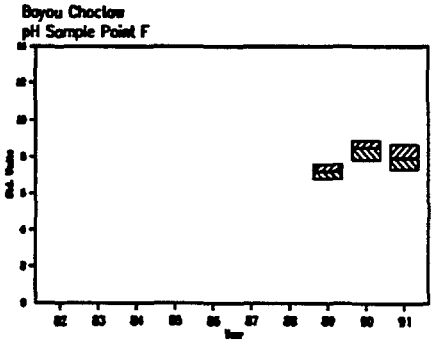
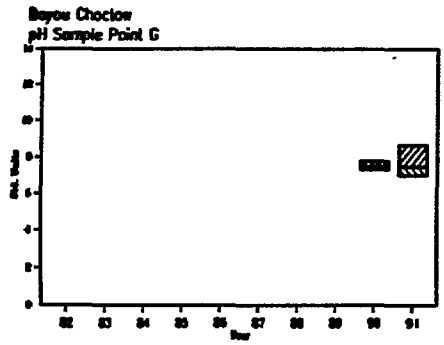
pH Sample Point B

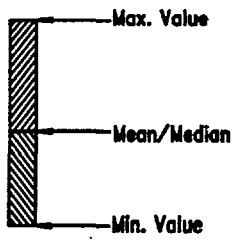

Boyou Choctow
pH Sample Point C


Boyou Choctow
pH Sample Point D


Boyou Choctow
pH Sample Point E


Boyou Choctow
pH Sample Point F

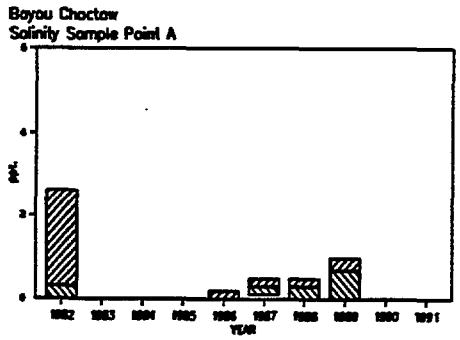


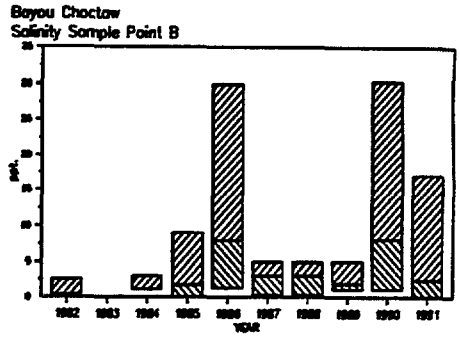


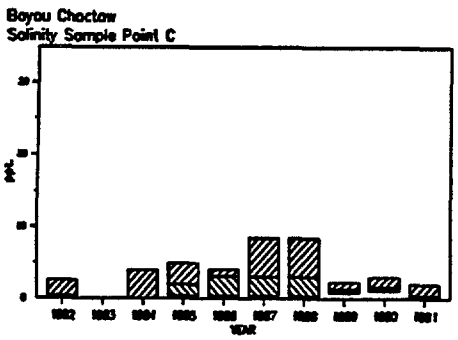
NOTE: Scale between stations changes to show long term variation with greater amplitude.

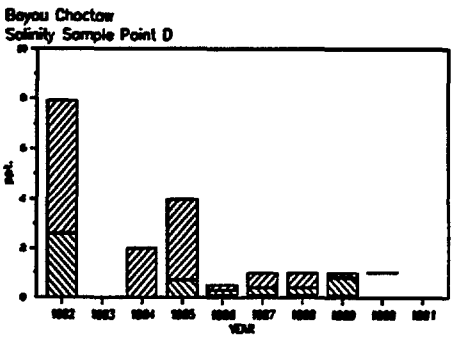
5.2.1.2 Salinity (SAL)

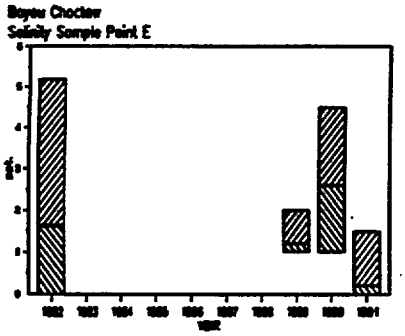
Salinities remained low, less than 3 ppt, at all monitor stations except B which measured 17 ppt in October 1991 and could possibly have received offsite contamination from a neighboring facility.

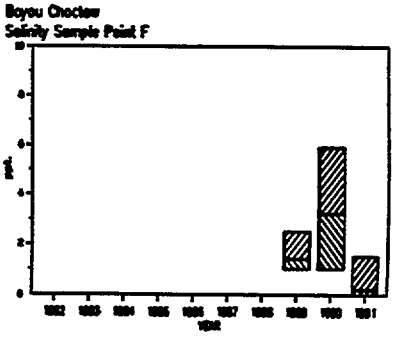


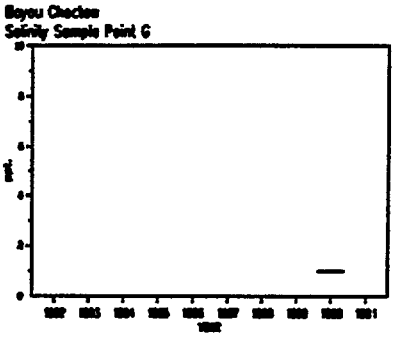








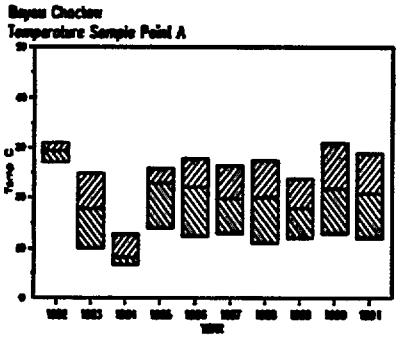


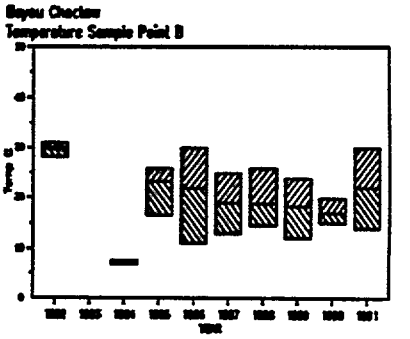


Salinity at sample point G was below detection limits in 1991.

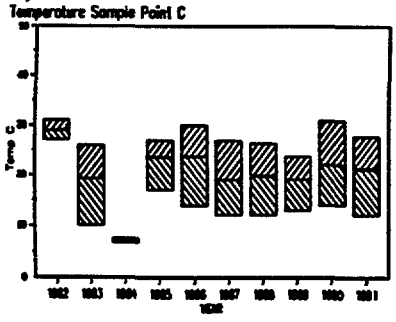
5.2.1.3 Temperature

There was a slight decline in temperature observed at all monitoring stations. Temperature fluctuations are attributed solely to meteorological conditions since Bayou Choctaw produces no thermal discharges.

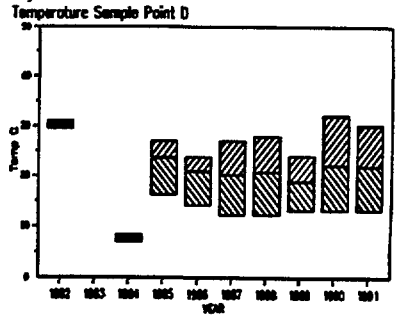




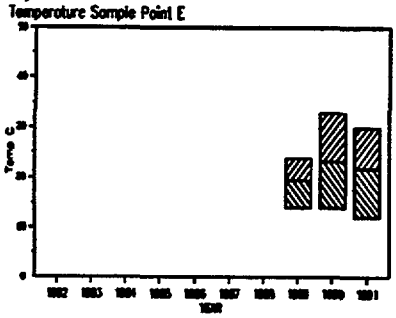
Bayou Choctaw
Temperature Sample Point C



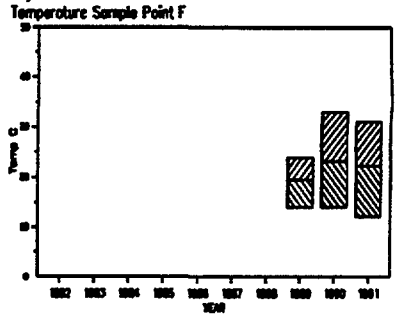
Bayou Choctaw
Temperature Sample Point D



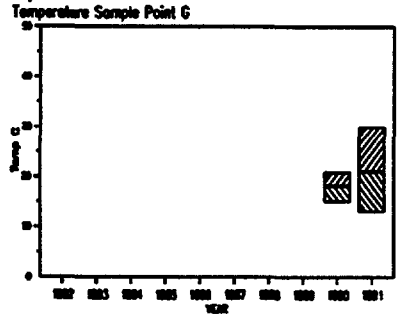
Bayou Choctaw
Temperature Sample Point E



Bayou Choctaw
Temperature Sample Point F

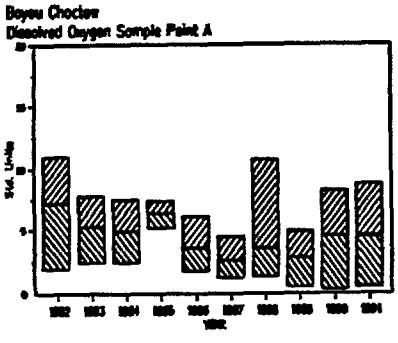


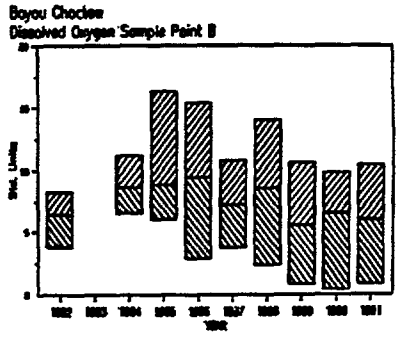
Bayou Choctaw
Temperature Sample Point G

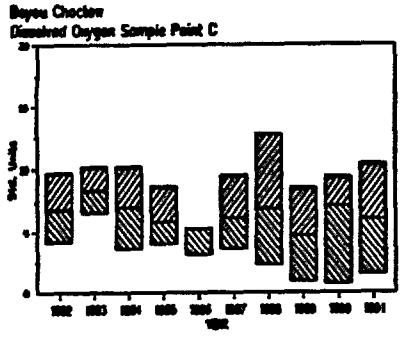


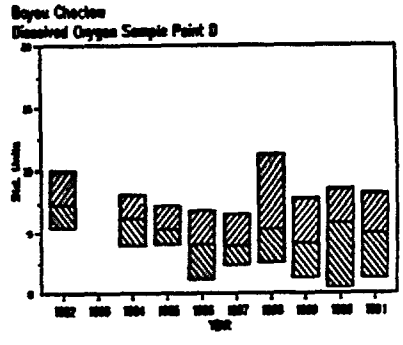
5.2.1.4 Dissolved Oxygen (DO)

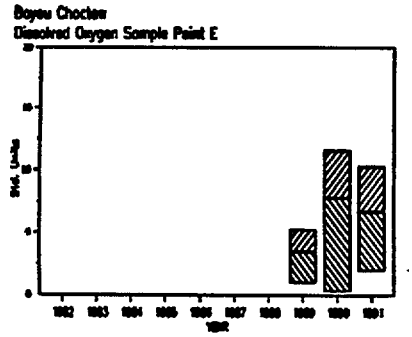
The consistency in DO observations suggests that SPR runoff and discharges do not significantly reduce the DO of receiving waters. Low levels observed at various times of the year are attributed to low flow and minimal flushing typically observed at times in a wetland environment.

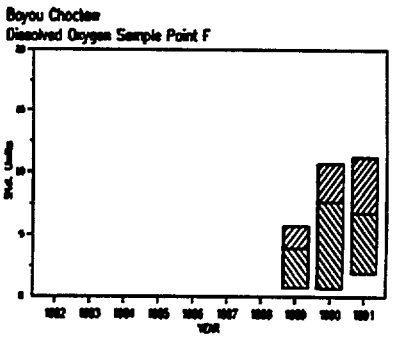






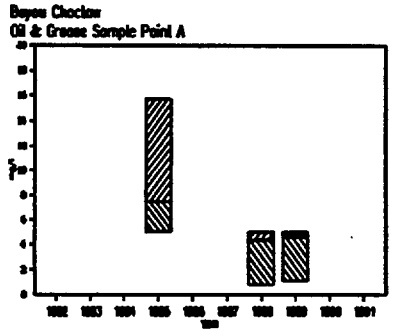


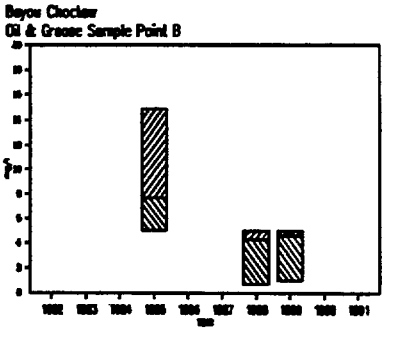


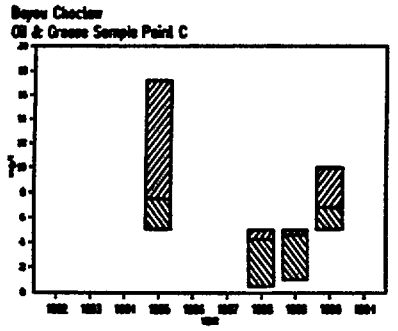


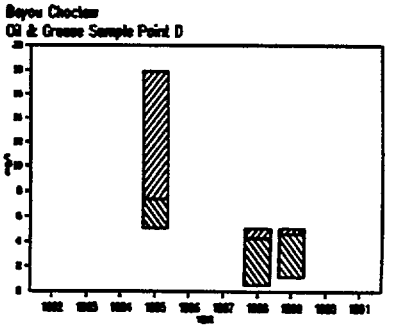
5.2.1.5 Oil and Grease

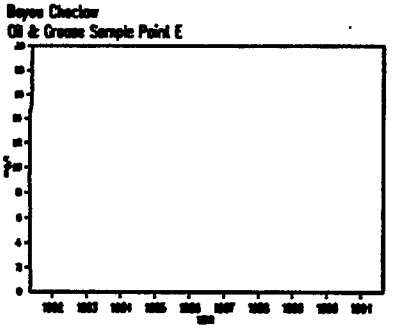
Oil and grease levels were below previously detectable levels (<5 mg/l) at all monitoring stations throughout 1991. These data are consistent with data collected since 1982. Data prior to 1988 were obtained using "wet chemistry" methods which had a lower detection limit of 5.0 mg/l. Data for 1988 through 1990 were obtained using instrumentation with lower detection levels of 1.0 mg/l. The data favorably reflect continued good site housekeeping and effective site spill prevention, control, and response efforts.

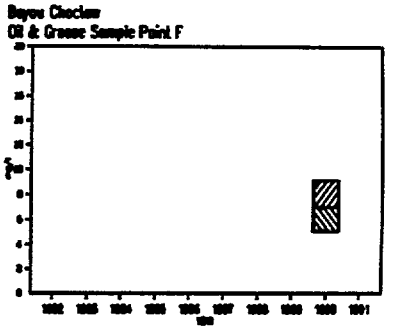


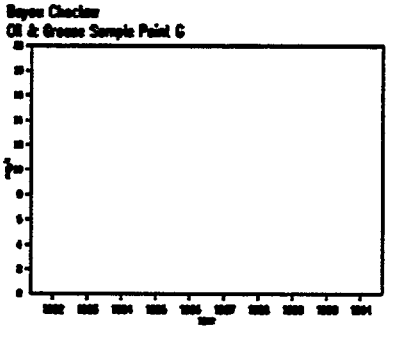












Oil & Grease at sample points E & G were below the detection limit of the instrument.

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5.2.1.6 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 have a relatively neutral pH.

b. The observed salinities were generally low. Those slightly elevated salinities observed were not attributed to SPR activity.

c. Temperature variations due to seasonal changes remained consistent with values observed in the past and with those expected, since there are no thermal processes used at any SPR site.

d. The lower DO levels observed are attributed to low flow and minimal flushing, typically observed in backwater swamp areas.

e. The consistently low oil and grease levels observed since 1982 indicate that site oil spills are effectively managed, minimizing any impact on the Bayou Choctaw environs.

5.2.2 Big Hill

Beginning July 1989, selected locations were established as monitoring stations (Figure 5-2) to assess site-associated surface water quality and to provide early detection of any surface water quality degradation that may result from SPR operations. Parameters such as pH, salinity, temperature, total organic carbon (TOC) or oil and grease, and DO, were monitored. Since Big Hill water quality monitoring program only began in 1989, there is insufficient data to formulate any trends. However, observation of surrounding areas indicates that there has been no observed adverse impact from SPR operations.

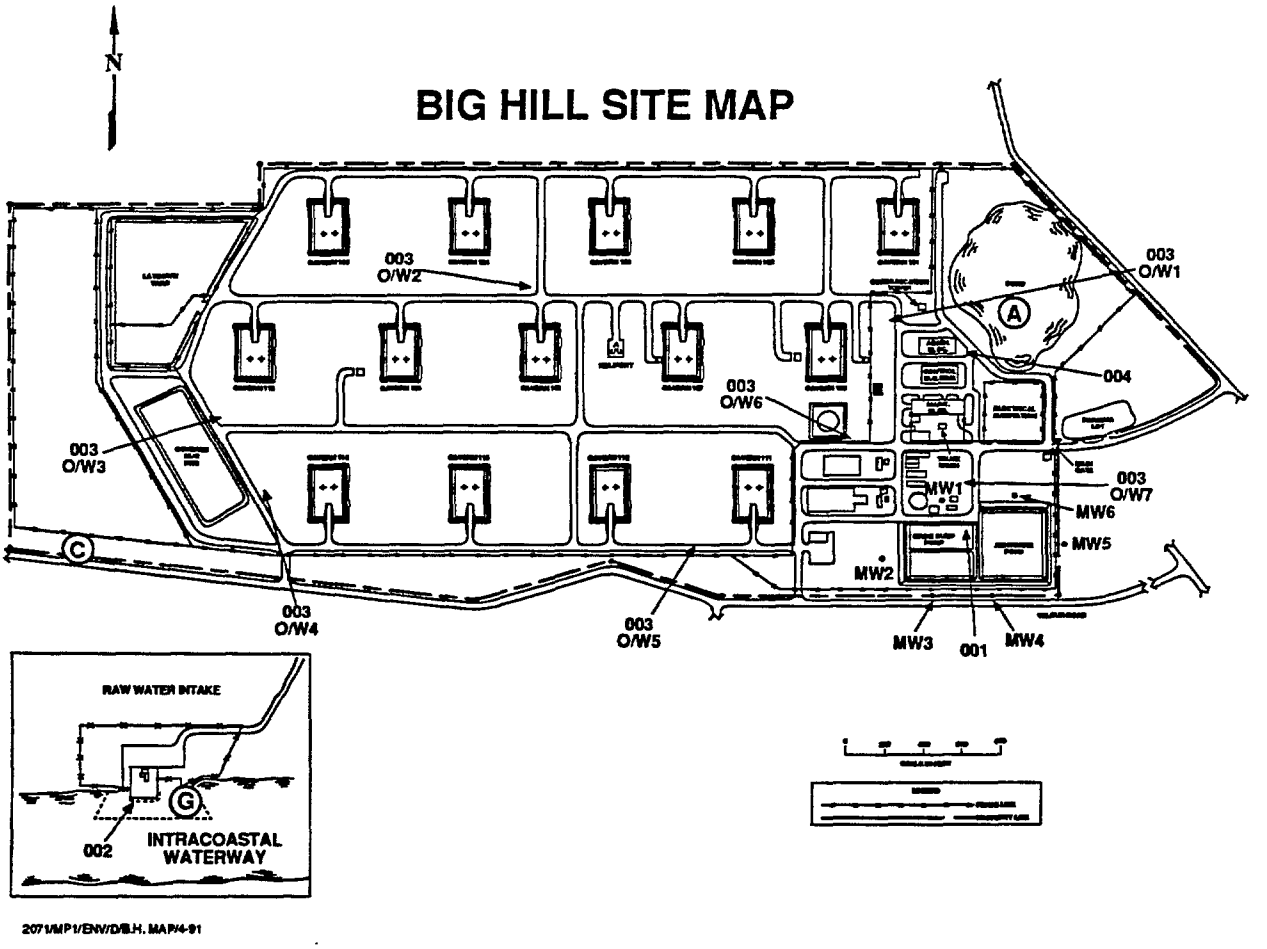


Figure 5-2 (Sheet 1 of 2). Big Hill Environmental Monitoring Stations

Discharge Monitoring Stations

001 Brine disposal to Gulf of Mexico

002 Hydroclone and blowdown at raw water intake structure

003 Stormwater discharges

O/W1 Stormwater from well pads 101, 102, 106, 107

O/W2 Stormwater from well pads 103, 104, 105

O/W3 Stormwater from well pads 108, 109, 110

O/W4 Stormwater from well pads 113, 114

O/W5 Stormwater from well pads 111, 112

O/W6 Stormwater from BHT-7 (crude oil surge tank) diked area

O/W7 Stormwater from pump and meter pads

004 Discharge from sewage treatment plant (TWC only)

Water Quality Monitoring Stations

A Ten Acre Pond (STP Pond) (A was combined with B due to access difficulty)

C Wilber Road Ditch - southwest of site

E Pier at Pipkin Pond (D was combined with E due to dense vegetation and low water level)

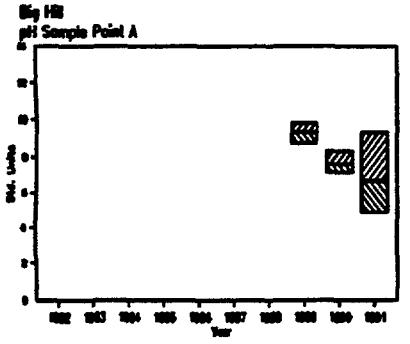
F Culvert crossover (Gator Hole) on RWIS road

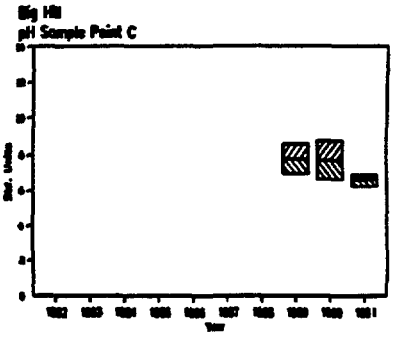
G RWIS at Intracoastal Waterway

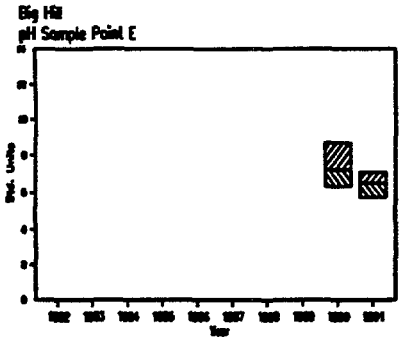
Figure 5-2 (Sheet 2 of 2). Big Hill Environmental Monitoring Stations

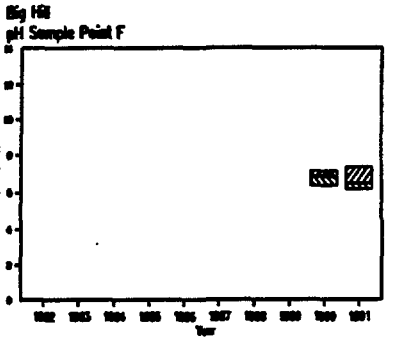
5.2.2.1 Hydrogen Ion Activity (pH)

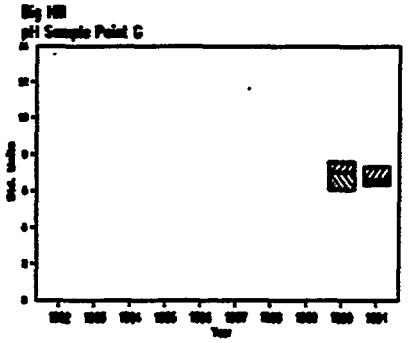
Initial data show the pH of the site and surrounding surface waters remained consistently between 6 and 9.





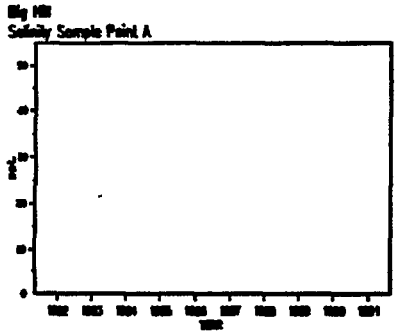


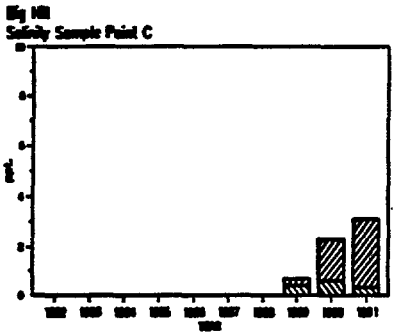


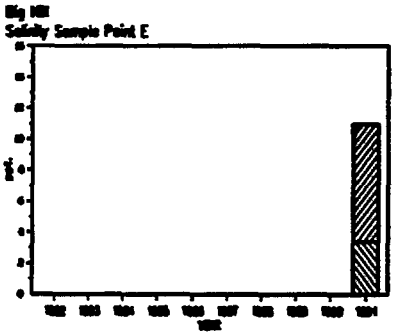


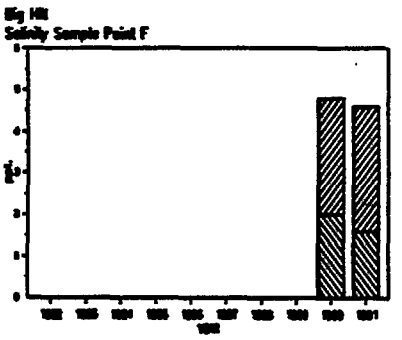
5.2.2.2 Salinity (SAL)

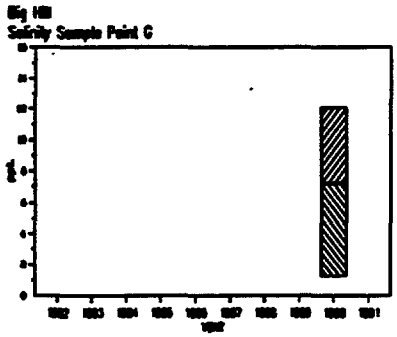
Salinities were generally low, however the further south the sample station, the slightly higher the salinity. This is expected based on marsh changes from a fresh to intermediate regime. Charts with missing bars indicate that values were less than detectable.





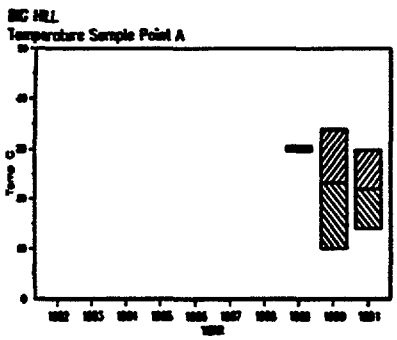


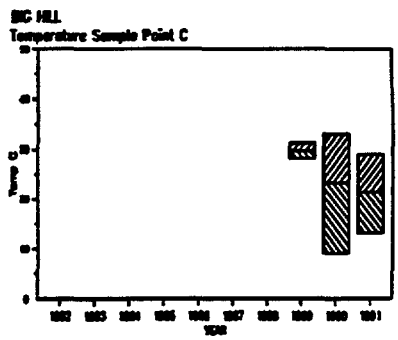


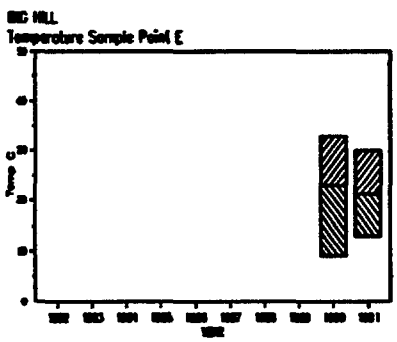


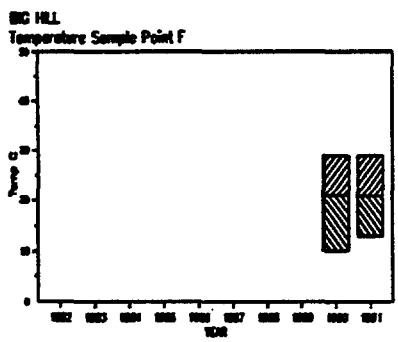
5.2.2.3 Temperature

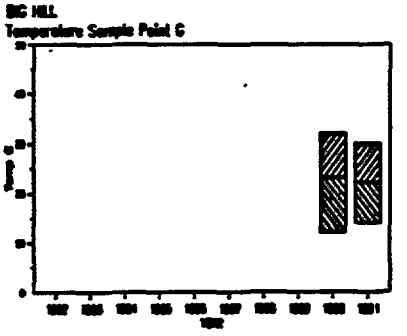
Temperature data for 1991 exhibited the characteristics expected from seasonal meteorological changes.





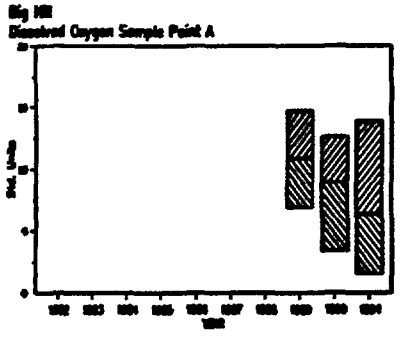


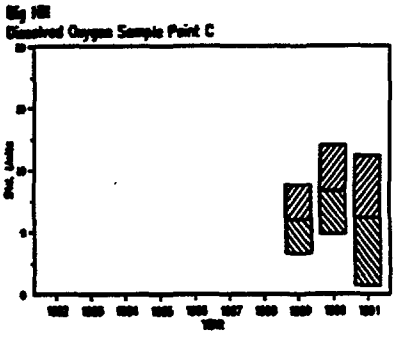


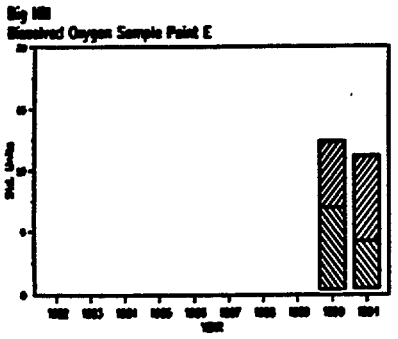


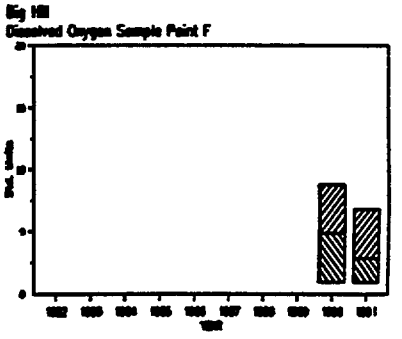
5.2.2.4 Dissolved Oxygen (DO)

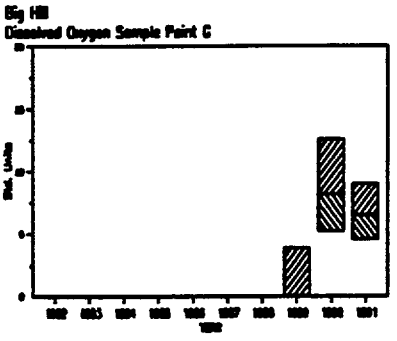
Dissolved oxygen fluctuated with the seasonal temperature changes as expected.





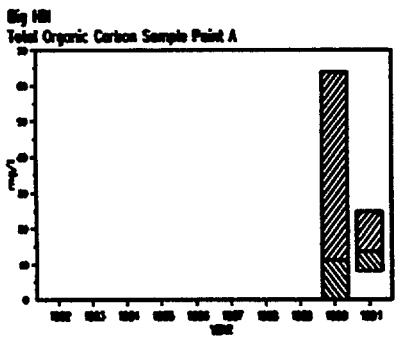


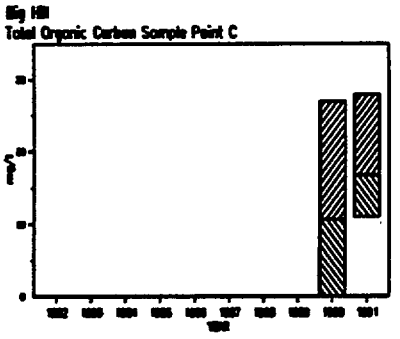


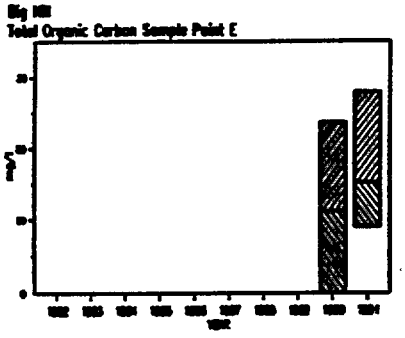


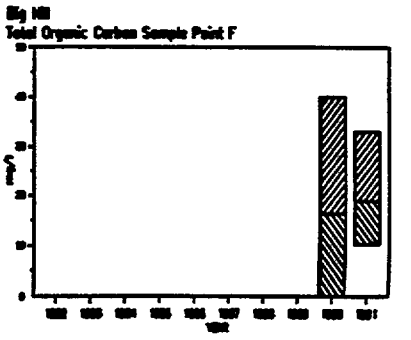
5.2.2:5 Total Organic Carbon (TOC)

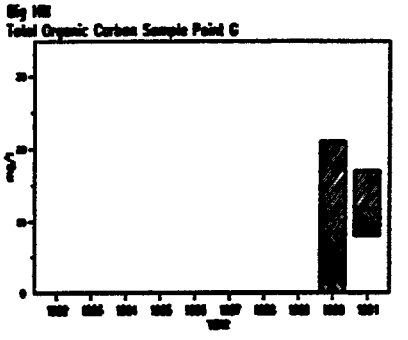
There was insufficient data to establish a trend for this parameter, however the high value seen at station A (1990) seemed to have little to no effect on the DO.











5.2.2.6 General Observations

The limited data do not allow accurate trending or substantial conclusions to be drawn. No significant impacts have been observed on site, or adjacent to it, leading to the belief that SPR operations are not affecting the environs.

5.2.3 Bryan Mound

The surface waters surrounding the Bryan Mound site were monitored throughout 1991. Blue Lake was sampled once monthly at each station. Mud Lake was sampled once monthly except during August and September when low tides restricted access to the lake.

Specific surface water monitoring stations are identified in Figure 5-3. Stations A through C and E through G are located along the Blue Lake shoreline to monitor effects of site runoff. Station D, located farther away from the site in Blue Lake, serves as a control. Stations H and I are located along the Mud Lake

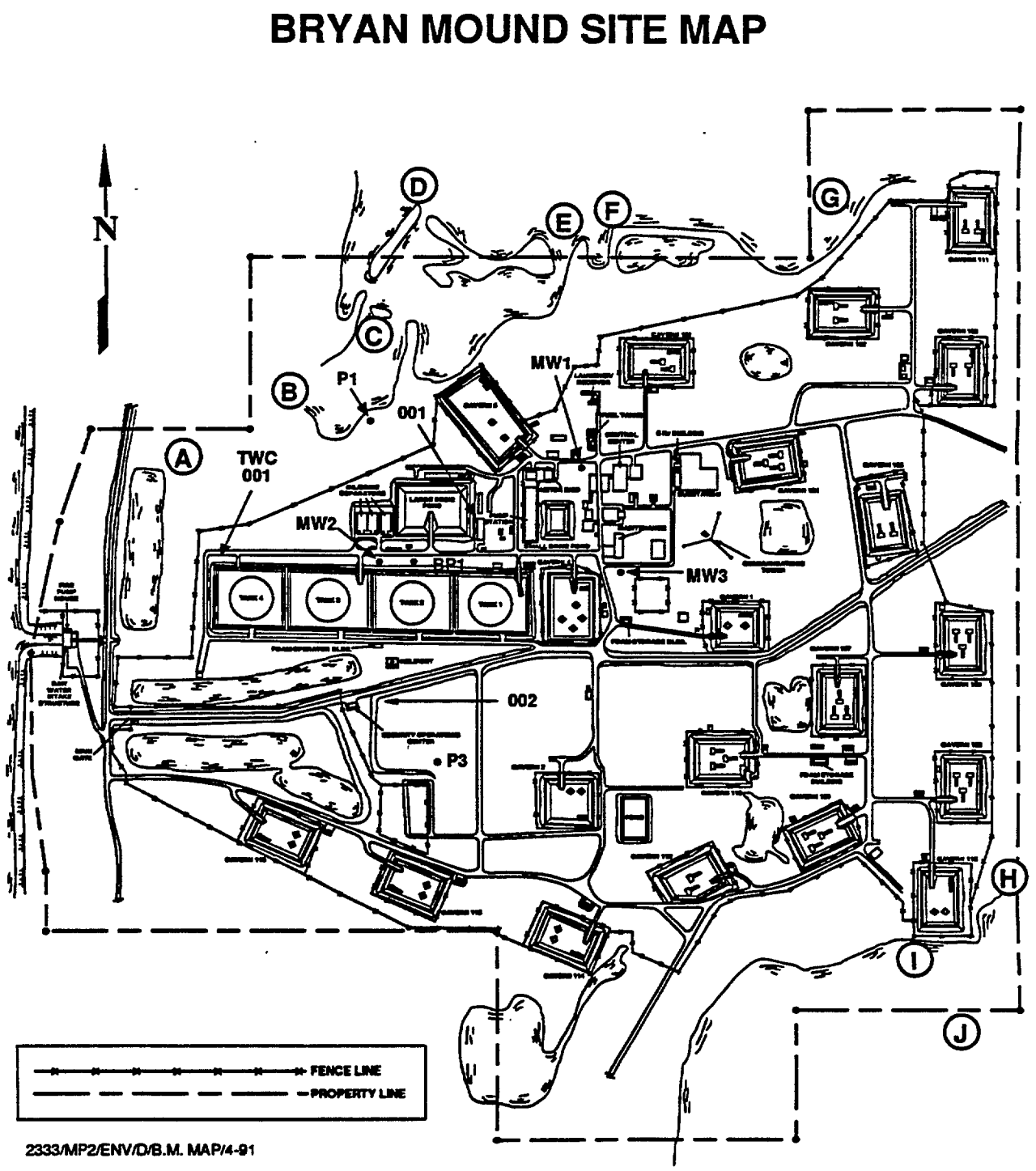


Figure 5-3 (Sheet 1 of 2). Bryan Mound Environmental Monitoring Stations

Monitoring Station J, located away from the shoreline in Mud Lake, serves as a control.

Discharge Monitoring Stations

001 Brine disposal

002 Discharge from the sewage treatment plant

Stormwater runoff from surge tank area (corresponds to TWC 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

Figure 5-3 (Sheet 2 of 2). Bryan Mound Environmental Monitoring Stations

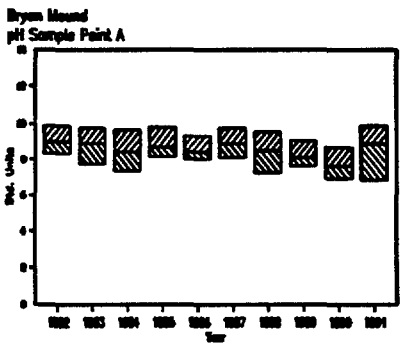
Shoreline station J, located away from the shoreline in Mud Lake, serves as a control.

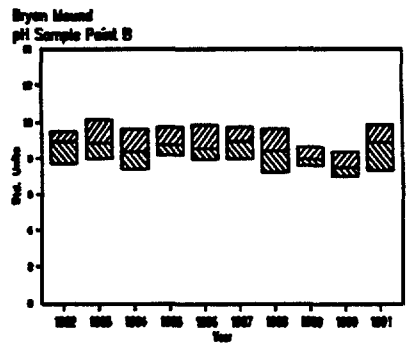
Specific parameters monitored in the Bryan Mound surface waters include pH, salinity, temperature, DO, and TOC. The parameters are discussed below and compared to 1982 through 1991 monitoring data.

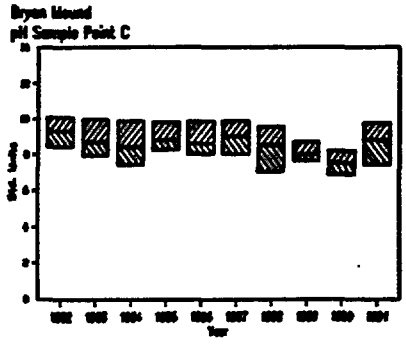
5.2.3.1 Hydrogen Ion Activity (pH)

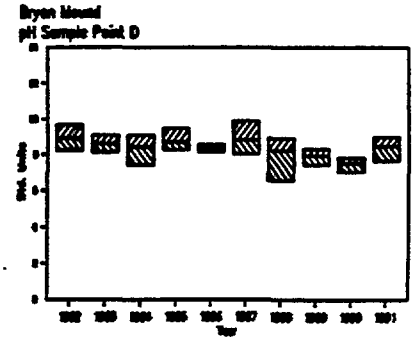
1991 pH data is relatively consistent with data from previous years. The consistently basic conditions indicate natural waters devoid of carbon dioxide and generally hard in regard to mineral content. Marine and estuarine waters, such as those in Blue Lake and Mud Lake, typically have somewhat elevated pH levels and high mineral contents. The pH is believed to fluctuate directly with the rate of carbon dioxide uptake as related to low primary productivity (lower pH) during cool periods and high primary productivity (higher pH) during warm periods.

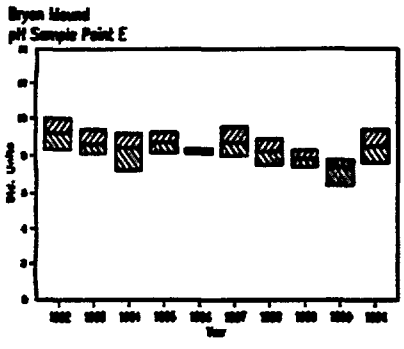
There were no known pH inducing impacts resulting in any pH changes to Mud Lake during 1991 or previous years as indicated by these comparisons. Thus, minor pH fluctuations in the Bryan Mound surface waters appear to be the result of seasonal weather and tidal variations rather than site activity.

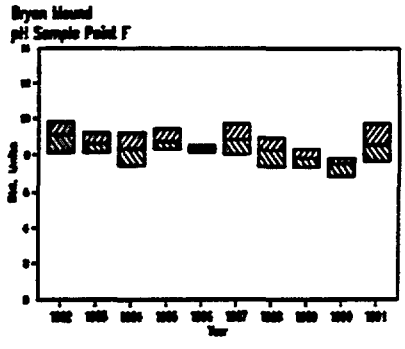


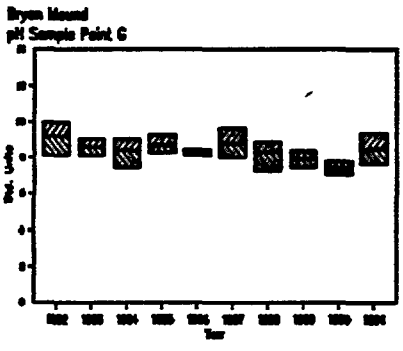



Bryan Mound
pH Sample Point C

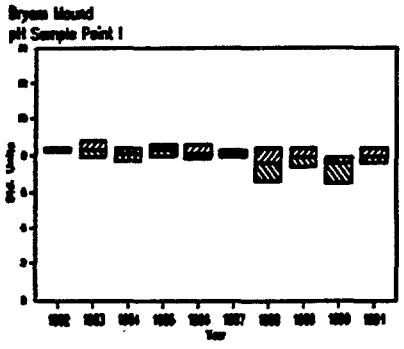

Bryan Mound
pH Sample Point D

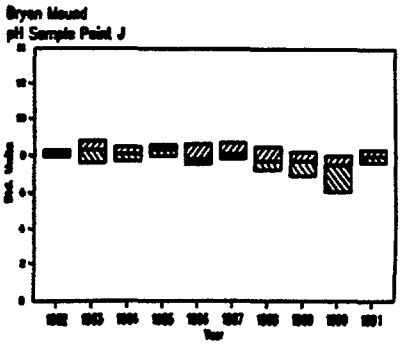

Bryan Mound
pH Sample Point E


Bryan Mound
pH Sample Point F


Bryan Mound
pH Sample Point G

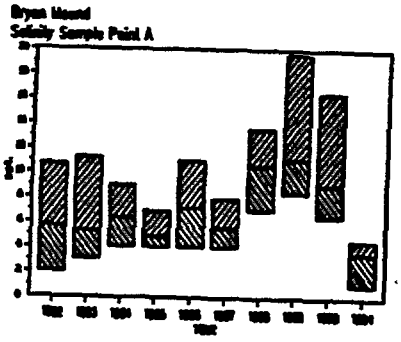

Bryan Mound
pH Sample Point H

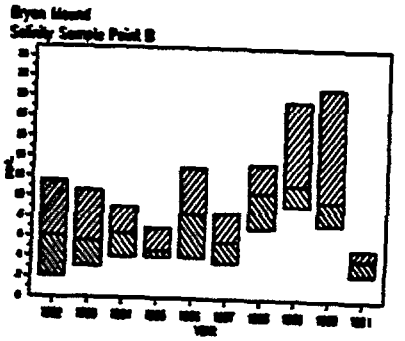


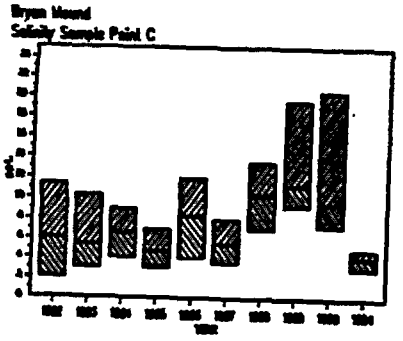


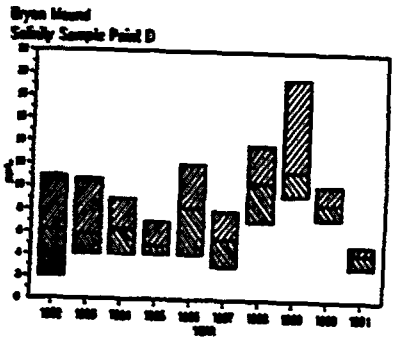
5.2.3.2 Salinity (SAL)

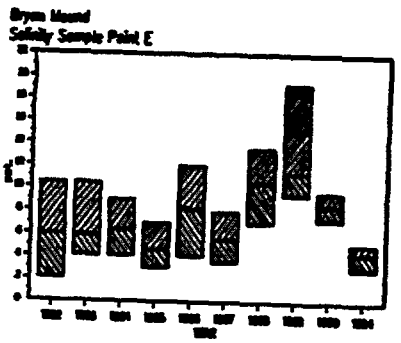
Salinity fluctuations in Blue Lake have been attributed to meteorologically induced conditions rather than site operations, since salinities observed at control sample points were consistent with those found along the site shoreline. The larger salinity variations in Mud Lake relative to Blue Lake are primarily attributed to the strong tidal and wind influence on the Lake and its more direct link with the Gulf of Mexico. Mean salinities were below the midpoint since 1982 in Mud Lake, and significantly so in Blue Lake. This phenomenon is attributed to heavy rainfall and flood conditions of the Brazos River system.

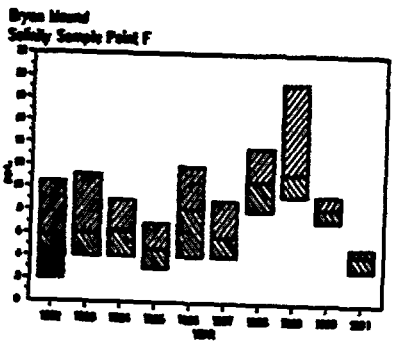

Bryan Mound
Salinity Sample Point A

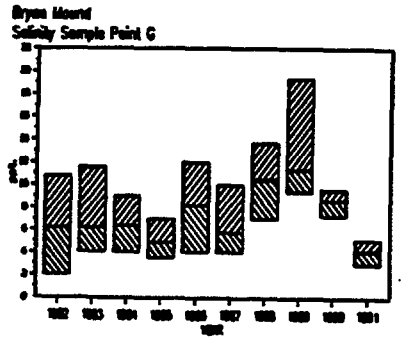

Bryan Mound
Salinity Sample Point B

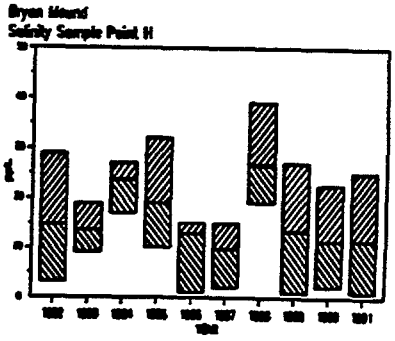

Bryan Mound
Salinity Sample Point C

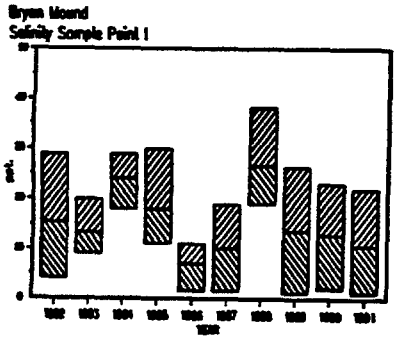

Bryan Mound
Salinity Sample Point D

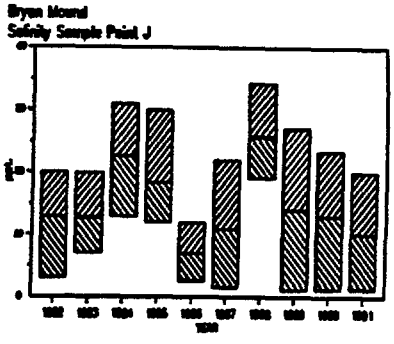

Bryan Mound
Salinity Sample Point E


Bryan Mound
Salinity Sample Point F





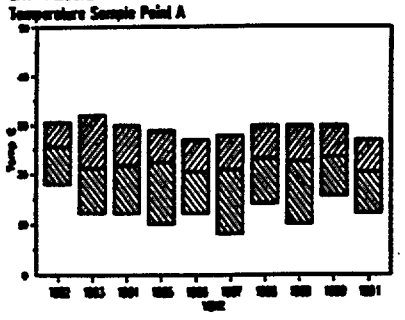




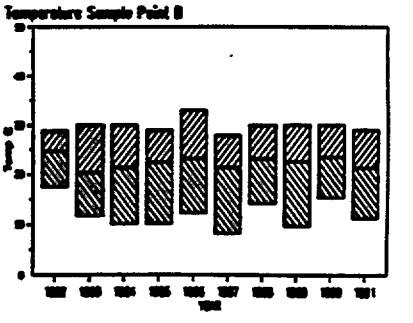
5.2.3.3 Temperature

Temperature data for 1991 was relatively consistent with data from previous years, which indicate fairly consistent temperatures with no influence from site operation.

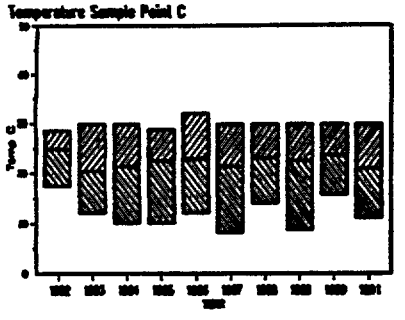
BROWN MOUND
Temperature Sample Point A



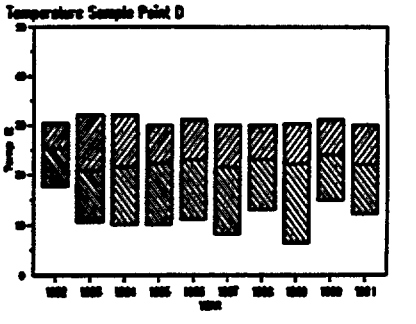
BROWN MOUND
Temperature Sample Point B



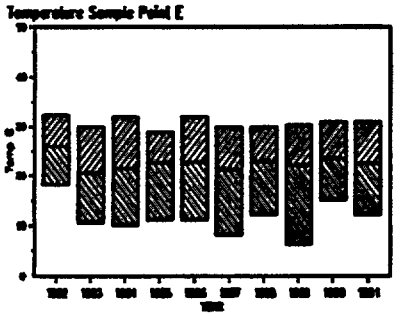
BROWN MOUND
Temperature Sample Point C



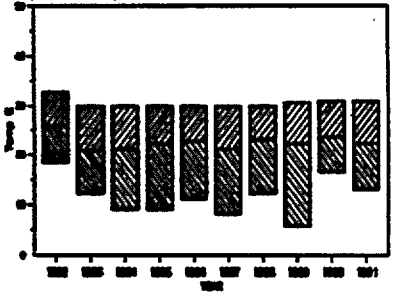
BROWN MOUND
Temperature Sample Point D

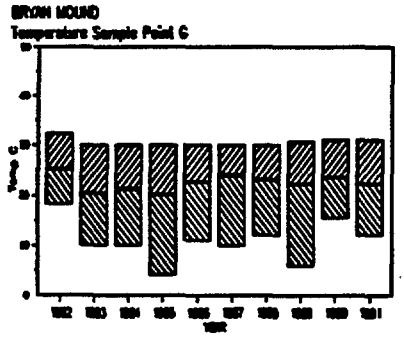


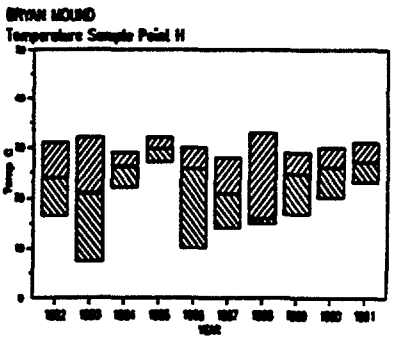
BROWN MOUND
Temperature Sample Point E

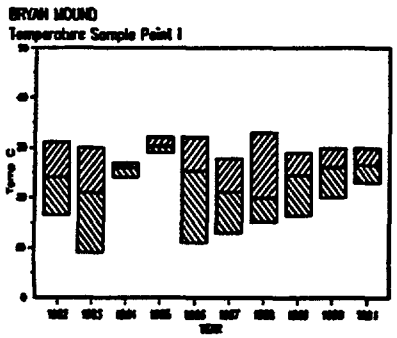


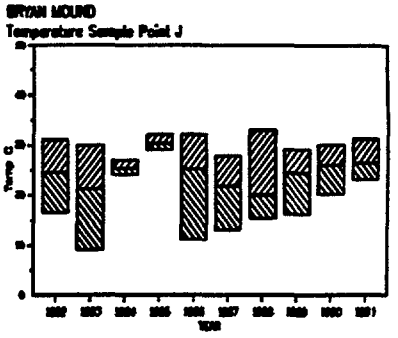
BROWN MOUND
Temperature Sample Point F





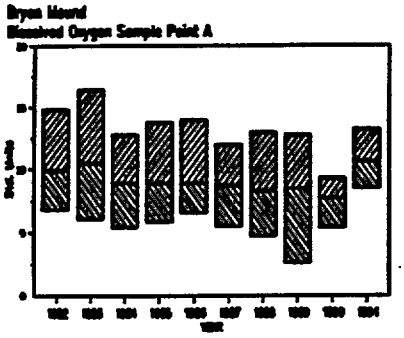


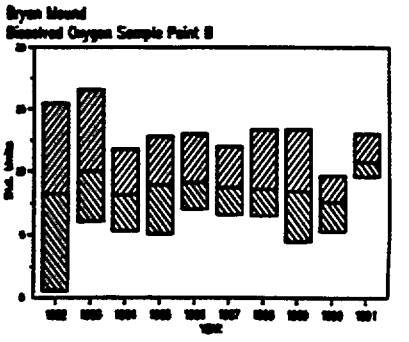


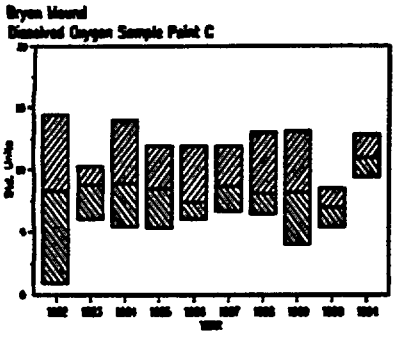


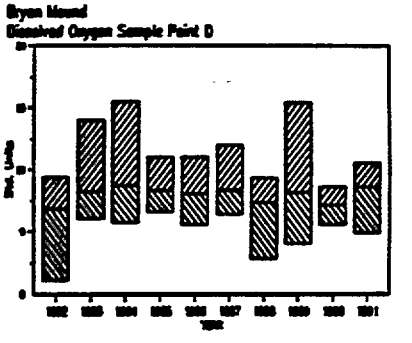
5.2.3.4 Dissolved Oxygen (DO)

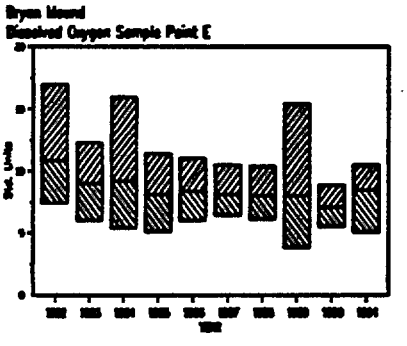
The DO levels in 1991 were consistent with that observed since 1982. The DO ranges observed are considered beneficial to the aquatic organisms inhabiting these lakes. Fluctuations in DO levels were attributed to the inverse relationship between temperature and DO as well as seasonal fluctuations in primary organic productivity, and meteorological factors such as wind driven mixing.

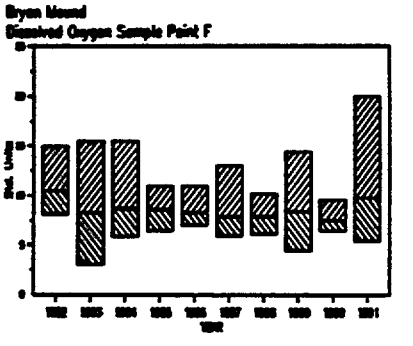

Bryan Mound
Dissolved Oxygen Sample Point A

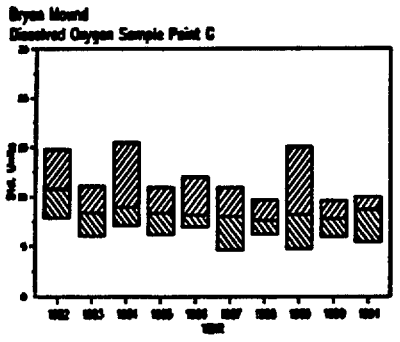

Bryan Mound
Dissolved Oxygen Sample Point B

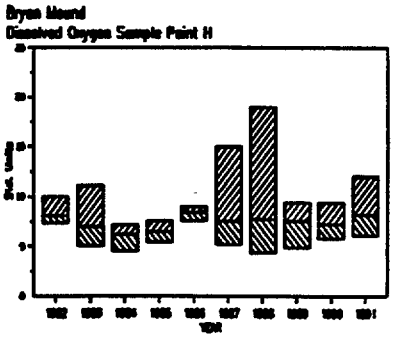

Bryan Mound
Dissolved Oxygen Sample Point C

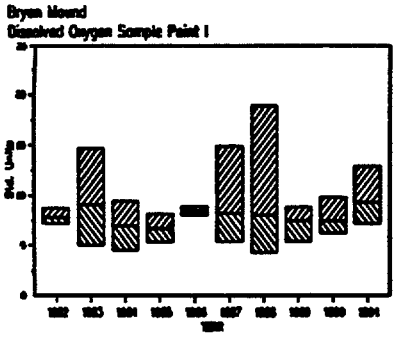

Bryan Mound
Dissolved Oxygen Sample Point D

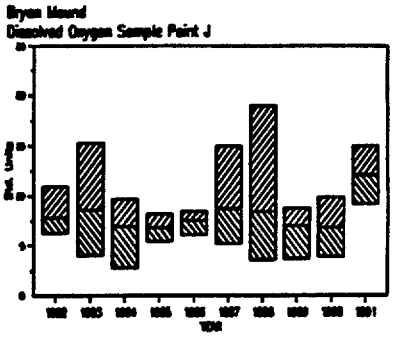

Bryan Mound
Dissolved Oxygen Sample Point E


Bryan Mound
Dissolved Oxygen Sample Point F



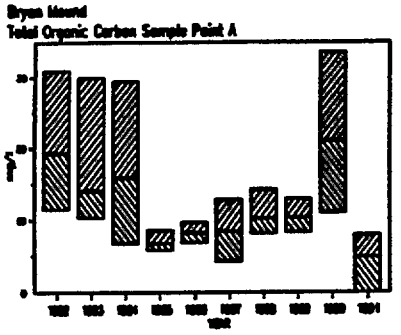


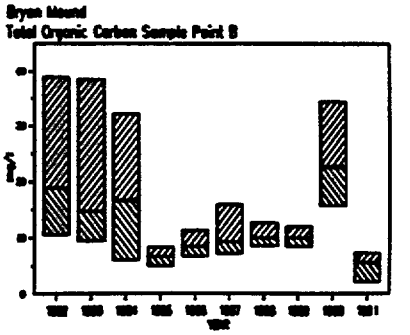


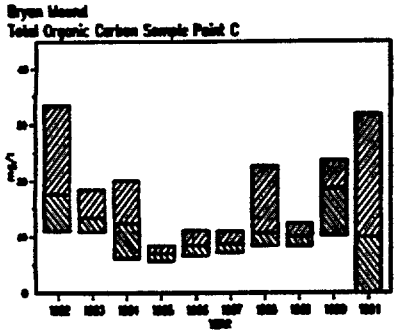


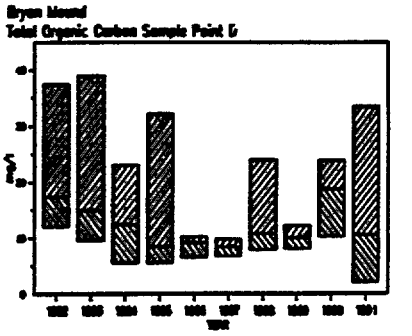
5.2.3.5 Total Organic Carbon (TOC)

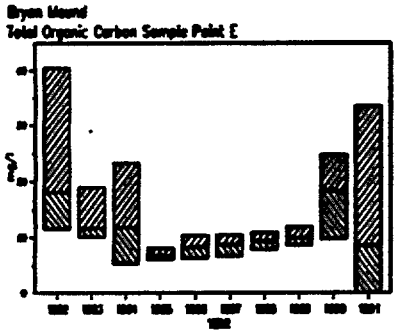
Average TOC data for 1991 is slightly lower than data collected from previous years. However, the TOC levels observed in both lakes are still consistent with healthy conditions, and a stable oxygen demand.

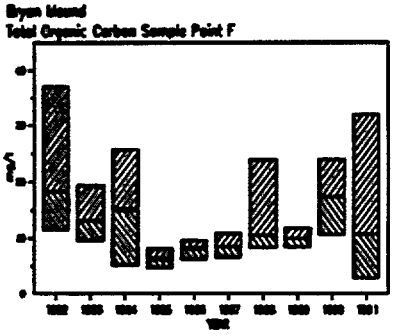

Bryan Mound
Total Organic Carbon Sample Point A

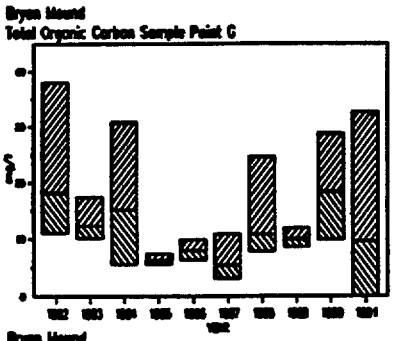

Bryan Mound
Total Organic Carbon Sample Point B

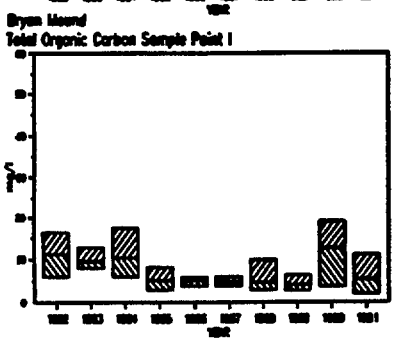

Bryan Mound
Total Organic Carbon Sample Point C

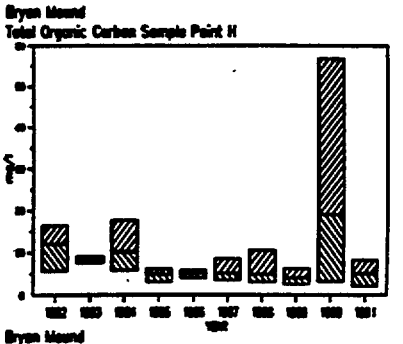

Bryan Mound
Total Organic Carbon Sample Point D

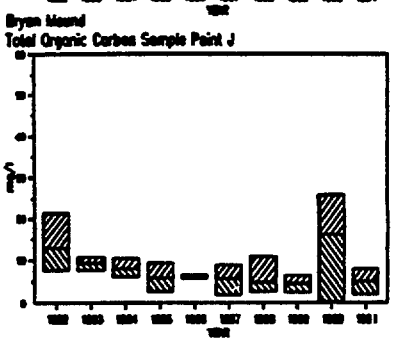

Bryan Mound
Total Organic Carbon Sample Point E


Bryan Mound
Total Organic Carbon Sample Point F









5.2.3.6 Additional Water Quality Monitoring

Visual surveys of adjacent water bodies were performed periodically to monitor those climatic events and environmental perturbations that may affect the SPR either directly or by association. Survey findings for 1991 were negative.

5.2.3.7 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 stable and predominantly neutral in Blue Lake and Mud Lake. This is consistent with the observed characteristic alkalinity and relative water hardness data from previous years.

b. Salinity levels in Mud Lake were lower than that observed during previous years, significantly so in Blue Lake. Salinity fluctuations during and among years are attributed to meteorologically induced conditions and previous industrial activity rather than site operations, and 1991 experienced heavy rainfall and local flooding in the vicinity.

c. Levels of DO remained moderate and fairly constant throughout the year. Temperature, DO and, however the elevated TOC data suggest a return to periods of normal primary productivity.

d. Mud Lake experiences more pronounced changes in water quality than Blue Lake. The more direct link of Mud Lake with the Gulf of Mexico and the frequent wind and tidal induced flushing are responsible for dramatic seasonal changes in water quality.

5.2.4 St. James Terminal

St. James Terminal is located in a low-lying agricultural area beyond 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 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 5-4) 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 providing a strong assimilative capacity. The intermittent nature of discharges from site outfalls, the characteristic hydrographic features of the Mississippi River, and a state-conducted water quality monitoring program limit the value of a site-directed water quality monitoring program in the Mississippi River. There are no other surface waters located near the site.

ST. JAMES SITE MAP

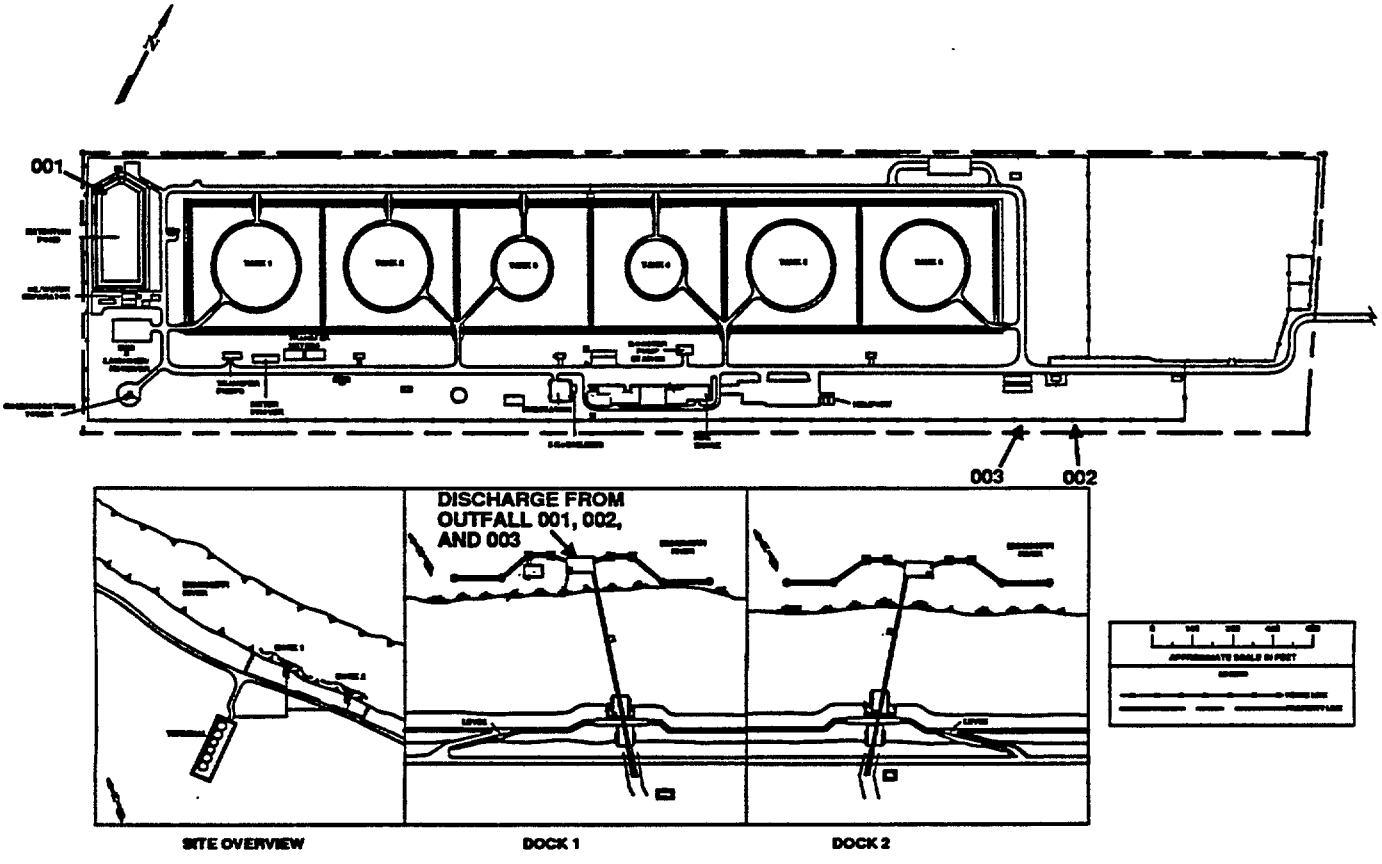


Figure 5-4 (Sheet 1 of 2). St. James Terminal Environmental Monitoring Stations

Discharge Monitoring Stations

001 Discharge from retention pond

002 Discharge from package sewage treatment plant

003 Discharge from package sewage treatment plant

There are no water quality monitoring stations at St. James

Figure 5-4

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

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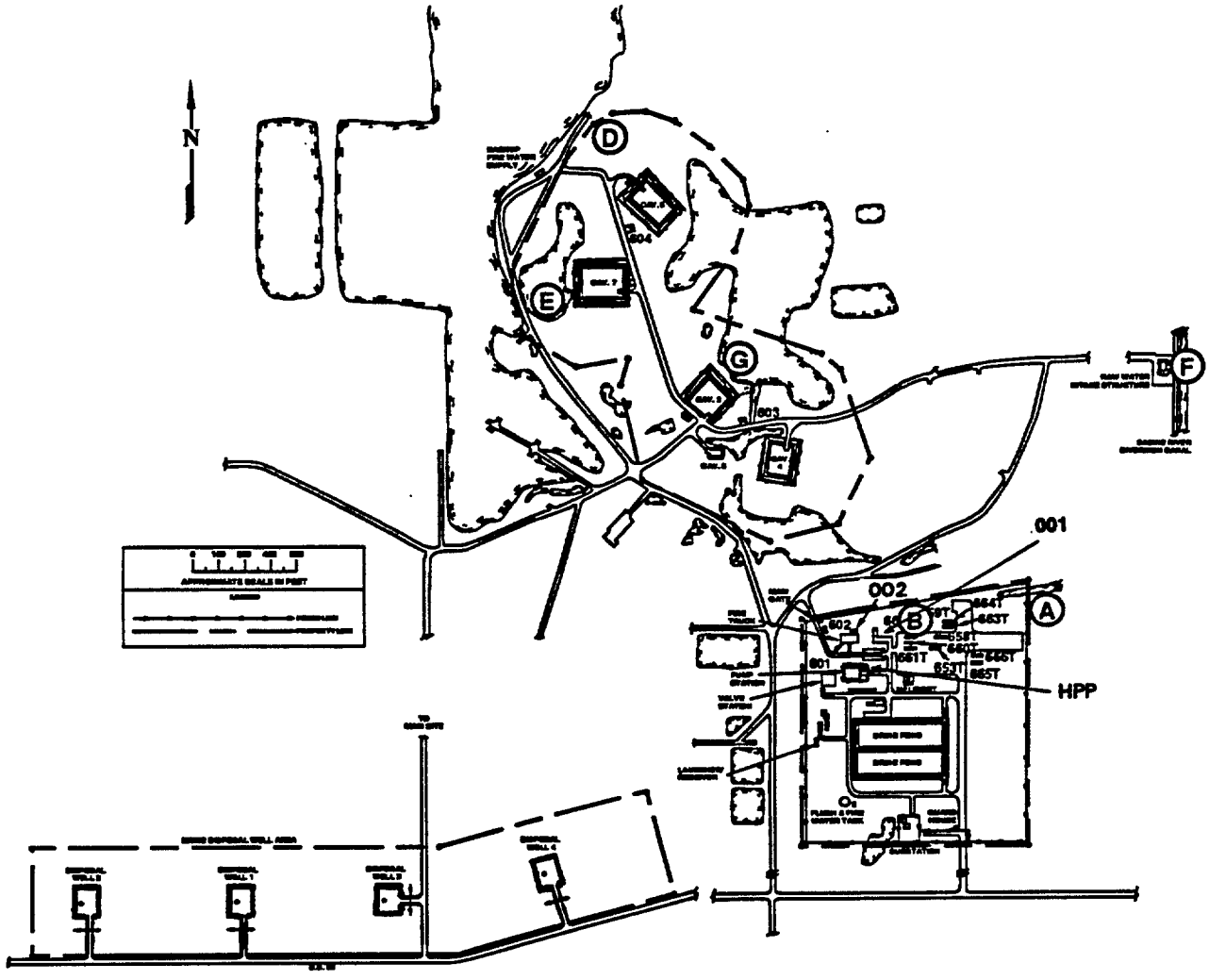
5.2.5 Sulphur Mines

Samples collected once monthly at each monitoring station were used to monitor surface water quality. Specific monitoring stations are identified in Figure 5-5. Station C was not monitored during 1990 due to access problems associated with construction activities by an adjacent landowner. Specific parameters monitored in the Sulphur Mines surface waters were pH, salinity, TSS, temperature, oil and grease, and DO. These data are summarized and compared to data collected since 1982.

The Sulphur Mines site was decommissioned, and all crude oil transferred to West Hackberry and Big Hill in late 1991 and early 1992.

SULPHUR MINES SITE MAP



2336/MP2/ENV/DSH.MAP4-91

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

Discharge Monitoring Stations*

001 Discharge from sewage treatment plant

002 Stormwater discharge from high pressure pump pad

Stormwater discharge from well pads 2, 4, 6, and 7

Water Quality Monitoring Stations

A Drainage ditch at northeast corner of primary site

B Creek north of primary site

C Subsidence area (pump) replaced with G

D Impoundment north of Cavern 6

E Impoundment west of Cavern 7

F Intake structure

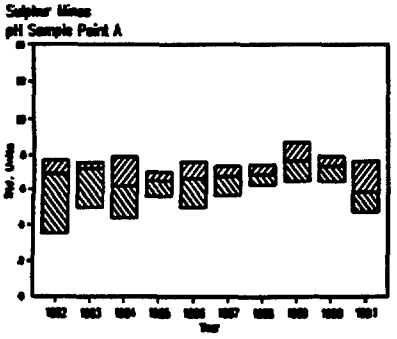
G Subsidence area

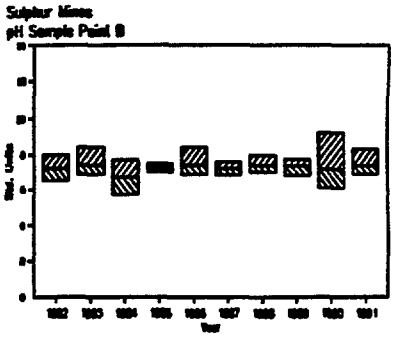
* The permit renewal submitted in 1990 regrouped discharges to simplify the reporting process

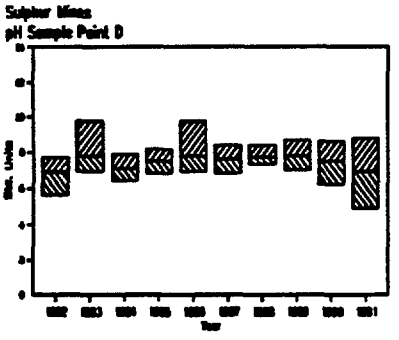
Figure 5-5 (Sheet 2 of 2). Sulphur Mines Environmental Monitoring Stations

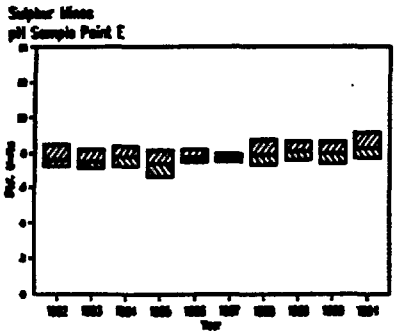
5.2.5.1 Hydrogen Ion Activity (pH)

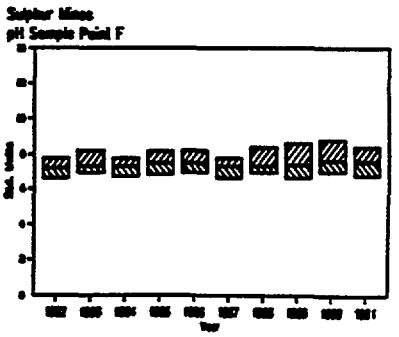
1991 pH data was consistent with corresponding data from previous years.

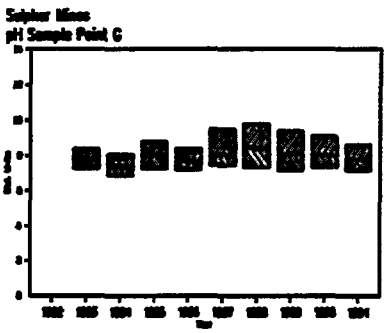






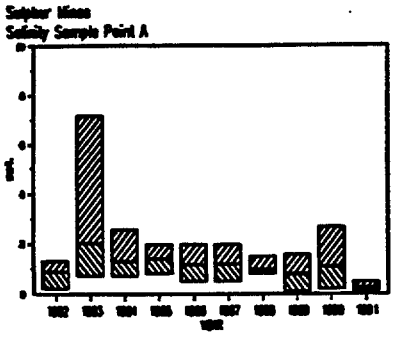


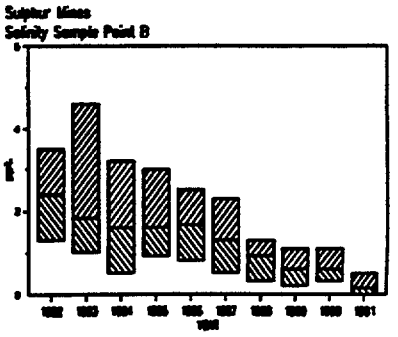


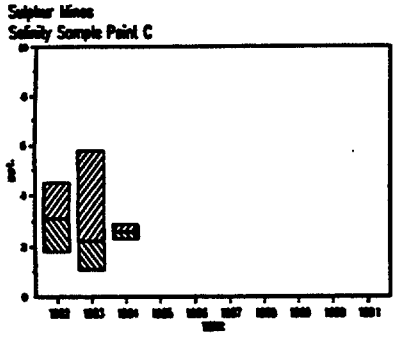


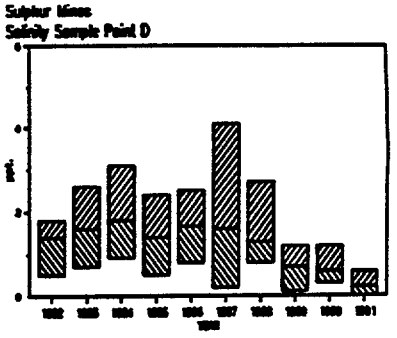
5.2.5.2 Salinity (SAL)

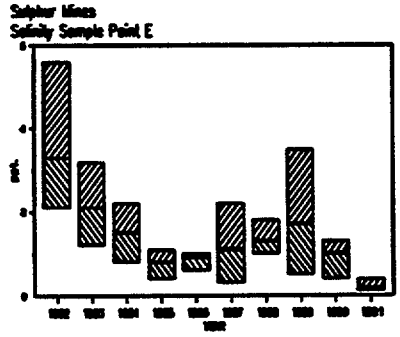
1991 salinity was slightly lower than overall salinities from previous years. Except for sample point F, all stations show low values, continuing their decline as in previous years. Station F appears slightly higher than last year, but still below 0.5 ppt. This suggests that any prior brine releases have not impacted the surface waters.

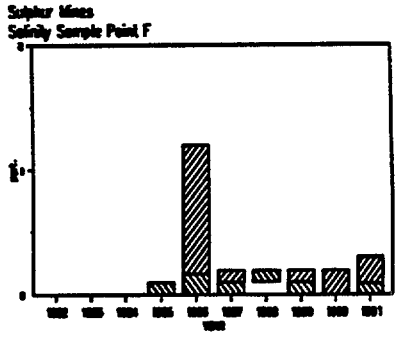

Sulphur Mines
Salinity Sample Point A

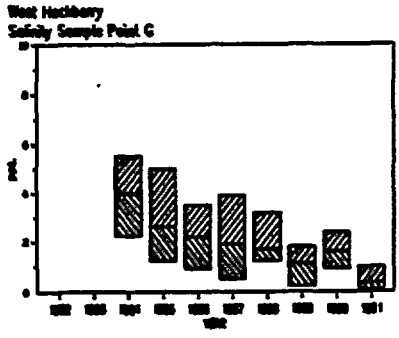

Sulphur Mines
Salinity Sample Point B


Sulphur Mines
Salinity Sample Point C


Sulphur Mines
Salinity Sample Point D


Sulphur Mines
Salinity Sample Point E


Sulphur Mines
Salinity Sample Point F

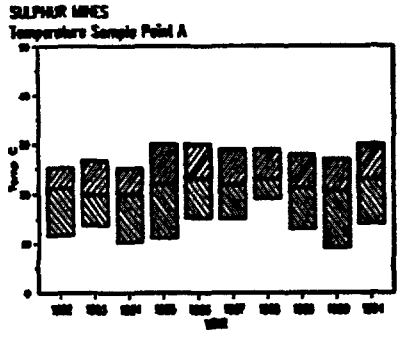


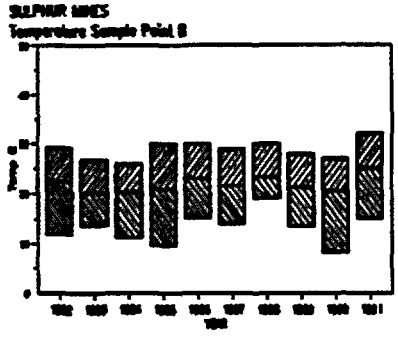
5.2.5.3 Total Suspended Solids (TSS)

TSS levels have been relatively consistent over the past years, 1982-1990. Since the site is located in an essentially wetland/marshy area, TSS fluctuations are a natural occurrence and do not reflect site operations or influences. To limit marginally related analyses and to standardize where possible across the SPR, the TSS data was not generated.

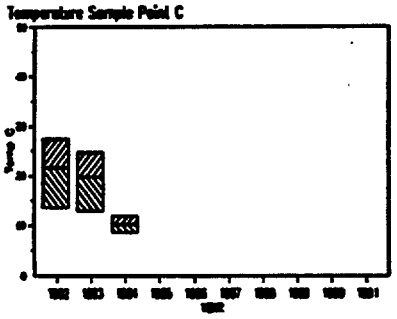
5.2.5.4 Temperature

The sample temperatures of the Sulphur Mines surface waters were generally conducive to supporting aquatic life throughout 1991. 1991 temperature data was comparable to data from previous years.

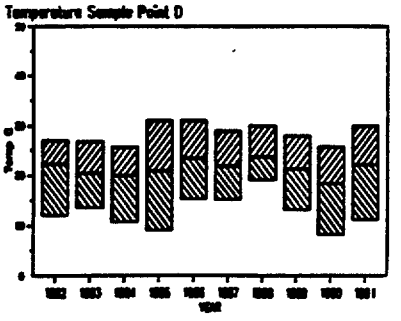




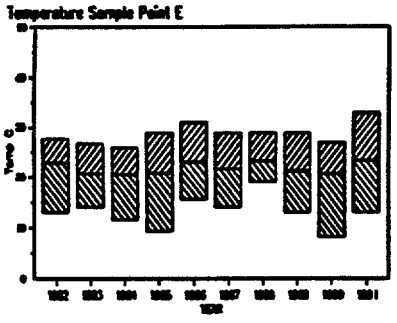
SULPHUR MINES
Temperature Sample Point C



SULPHUR MINES
Temperature Sample Point D

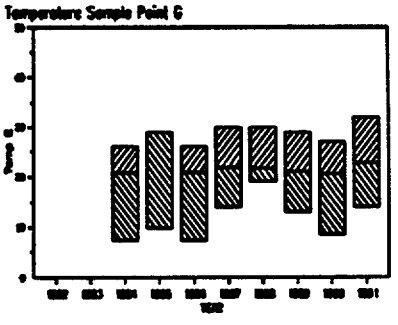


SULPHUR MINES
Temperature Sample Point E



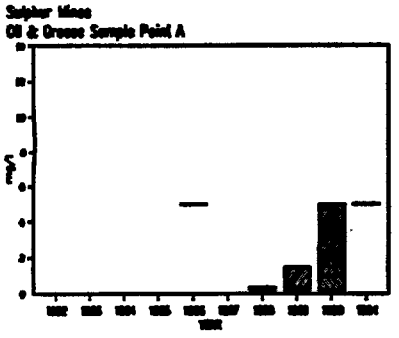
SULPHUR MINES
Temperature Sample Point F

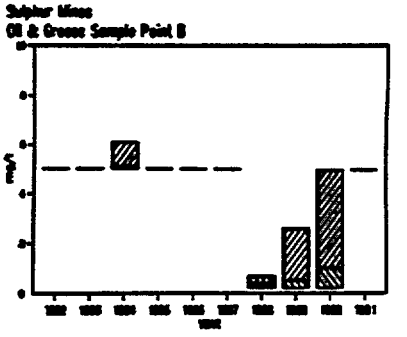
SULPHUR MINES
Temperature Sample Point G

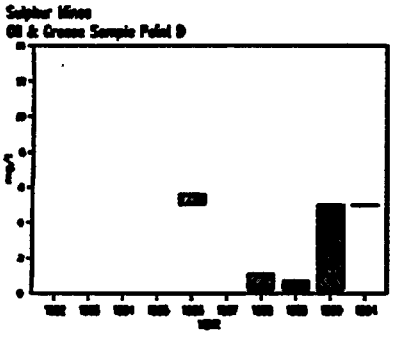


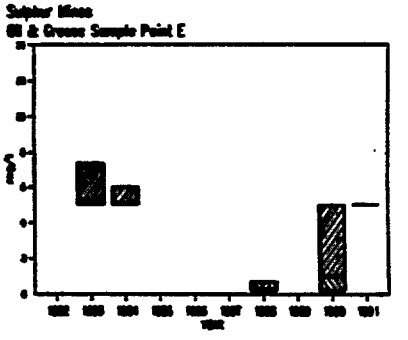
5.2.5.5 Oil and Grease

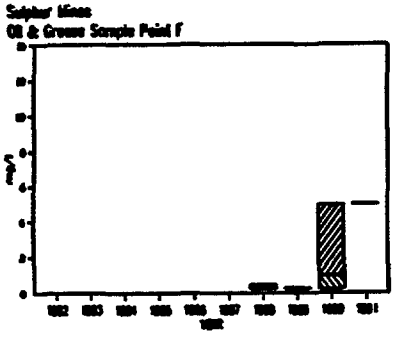
Oil and Grease levels were less than 5 mg/l at all monitoring stations throughout 1991. These data reflect favorably on the site spill prevention, control, and overall good housekeeping during 1991. These results are consistent with that collected during previous years. In 1988 through 1990 a more discrete analytical method was used enabling the SPR to have lower detection limits instead of the normal <5 mg/l, however equipment problems during 1991 caused analyses to be run using gravimetric procedure.

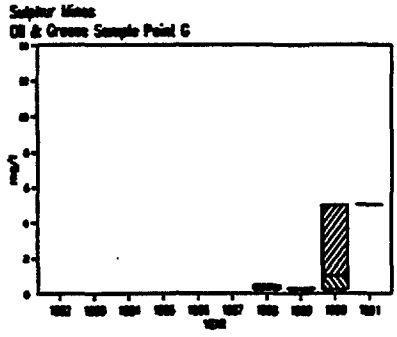






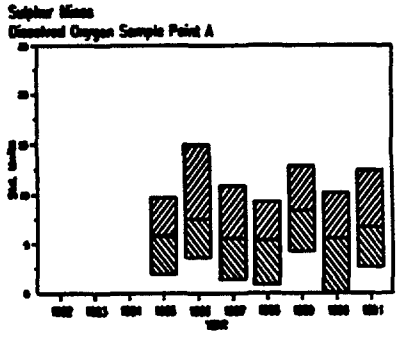






5.2.5.6 Dissolved Oxygen (DO)

Dissolved oxygen monitoring was performed only at station A throughout 1991. This station is located in a relatively stagnant drainage ditch that receives effluent from the site package sewage treatment plant. The sewage plant operated in compliance throughout 1991



5.2.5.7 General Observations

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

a. Overall, pH continued to be relatively neutral.

b. Changes in water temperature observed during years since 1982 are attributed to seasonal meteorological variation since the SPR has no thermal discharges.

c. The DO levels observed since 1985 have been relatively consistent, with only a sight deviation in 1986, and are attributed to natural factors as well as low BOD_5 levels in effluent from the site sewage treatment plant.

d. Stations B and G have leveled off after years of a steady decline in salinity suggesting a general reduction of salinity when compared to previous levels and the years of industrial activity in the area.

5.2.6 Weeks Island

The Weeks Island site is located on the Weeks Island salt dome approximately 30 m (100 ft) above sea level. The surrounding topography is of rather sharp relief with several small ponds. None of the SPR outfalls discharge directly into these ponds. Other surface waters at this site are intermittent in nature, draining rapidly and thoroughly after any precipitation. The site outfalls (Figure 5-6) discharge small volumes into surface runoff 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. Outfalls 004 and 01B are combined with 01A into a single surface drain, similar to the St. James arrangement.

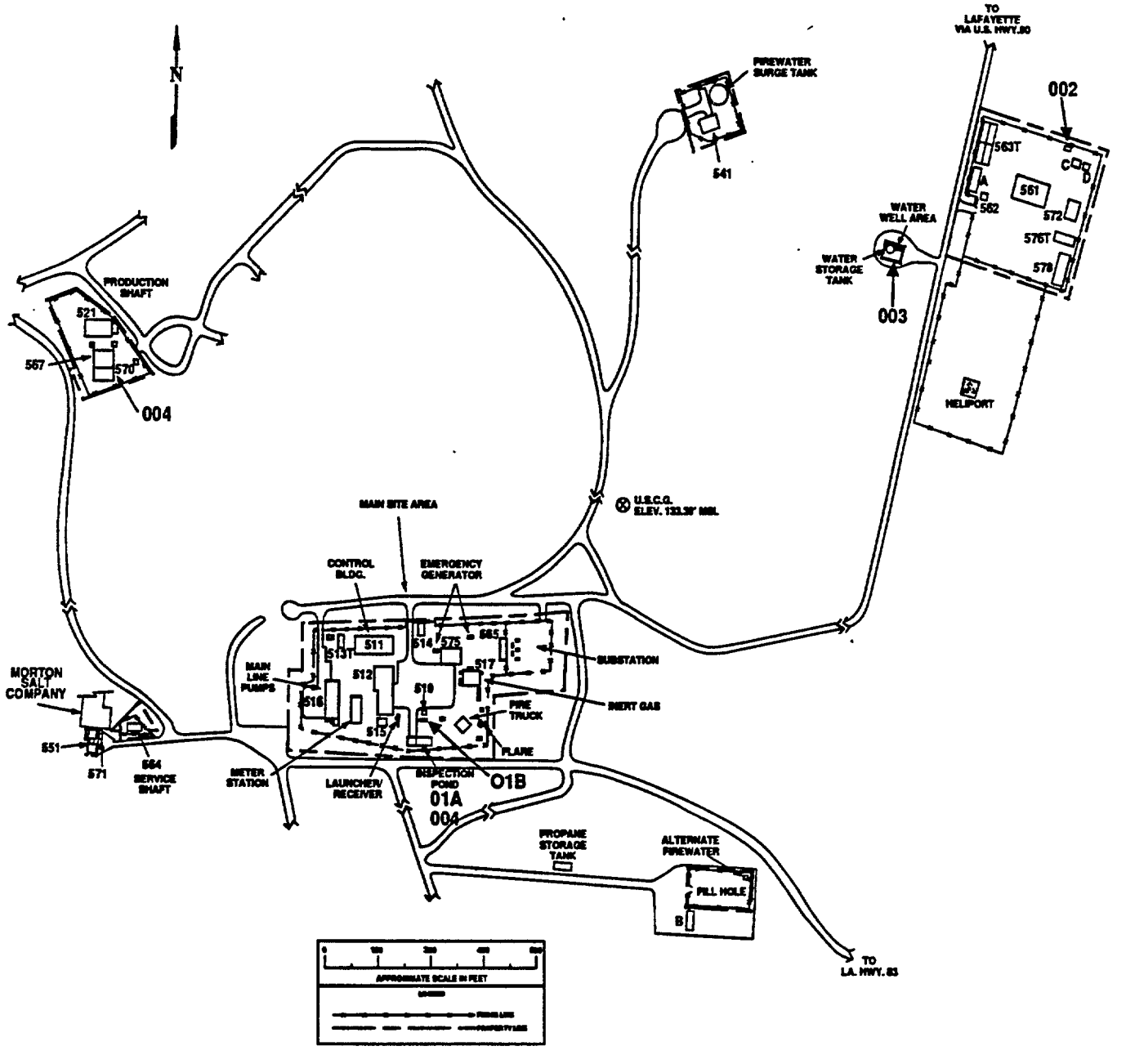


Figure 5-6 (Sheet 1 of 2). Weeks Island Environmental Monitoring Stations

Discharge Monitoring Stations

01A Stormwater runoff

01B Discharge from sewage treatment plant

002 Discharge from sewage treatment plant

003 Discharge from iron removal system

004 Discharge from mine air dryer condensate

There are no water quality monitoring stations at Weeks Island

Figure 5-6 (Sheet 2 of 2). Weeks Island Environmental Monitoring Stations

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5.2.7 West Hackberry

West Hackberry surface water quality was monitored by sampling once monthly at each station throughout 1991. Specific monitoring stations are identified in Figure 5-7. Specific parameters monitored in the West Hackberry surface waters include pH, salinity, temperature, TOC, and oil and grease. TOC was monitored only at station E corresponding to the NPDES permit requirement regarding stormwater discharges. Each parameter is discussed in the following sections.

5.2.7.1 Hydrogen Ion Activity (pH)

1991 data is consistent with data from previous years. Natural waters low in, or devoid of, carbon dioxide are medium hard to hard, with regard to mineral content, and characteristically have a slightly high pH. 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. A mildly high pH is beneficial to aquatic life and consistent with an environmentally sound ecosystem.

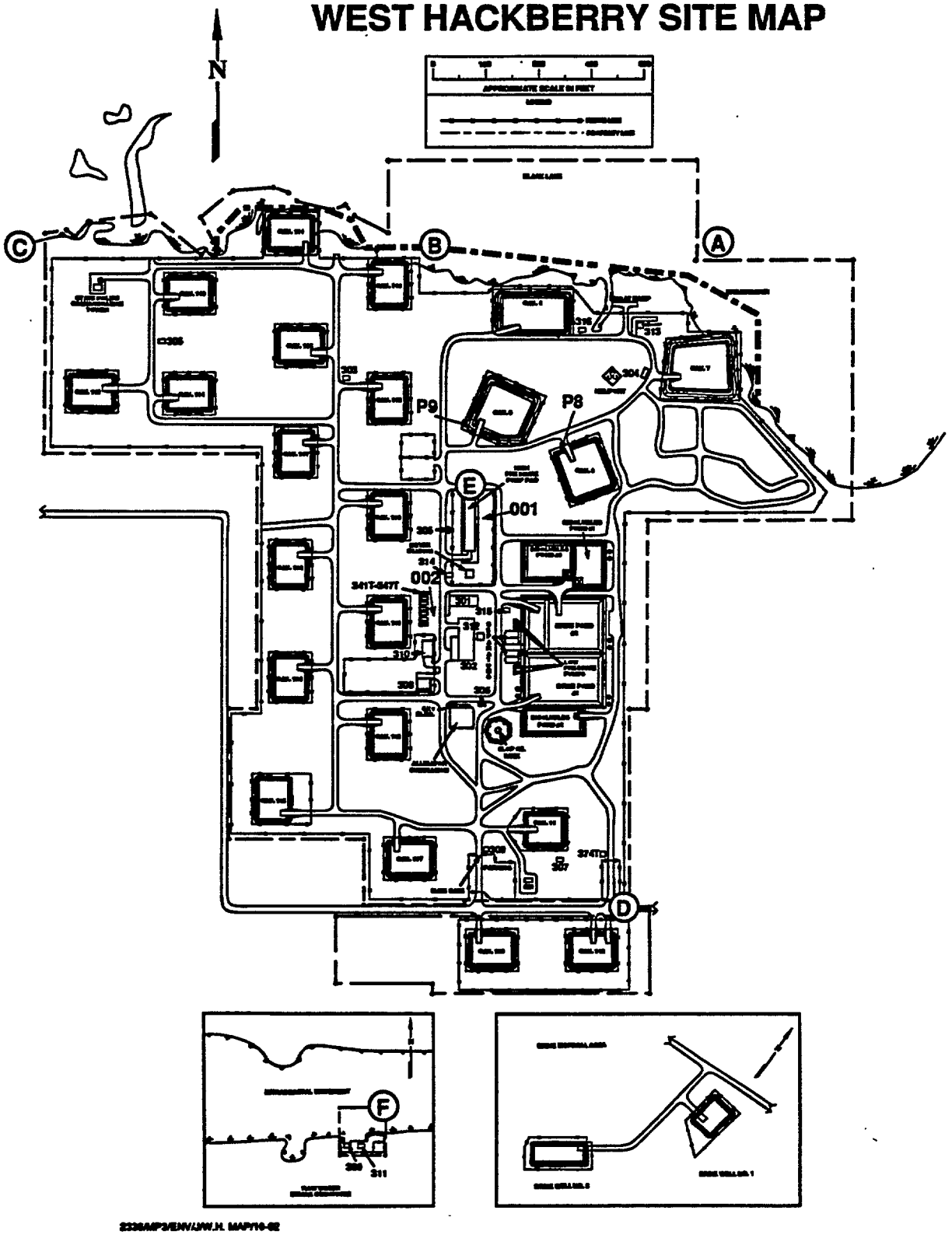


Figure 5-7

(Sheet 1 of 2). West Hackberry Environmental Monitoring Stations

Discharge Monitoring Stations

001 Brine disposal

002 Discharge from sewage treatment plant

003 (State) Stormwater and pump flush from high-pressure pump pad Stormwater runoff from well pads 6-9, 11, and 101-117

004 Stormwater from the Texoma/Lake Charles meter station

Water Quality Monitoring Stations

A Black Lake

B Black Lake

C Black Lake

D Southeast drainage ditch

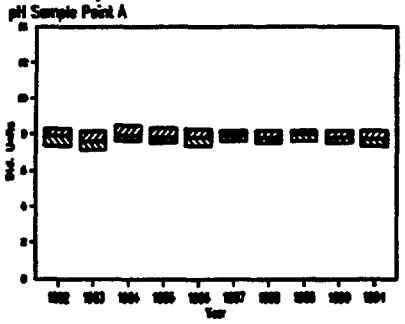
E High-pressure pump pad

F Raw water intake structure

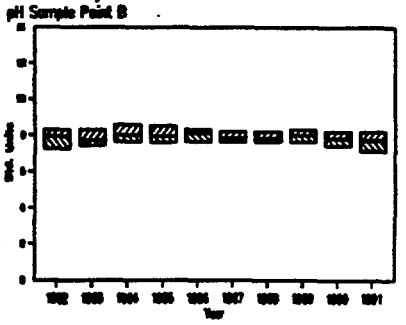
Figure 5-7

(Sheet 2 of 2). West Hackberry Environmental Monitoring Stations

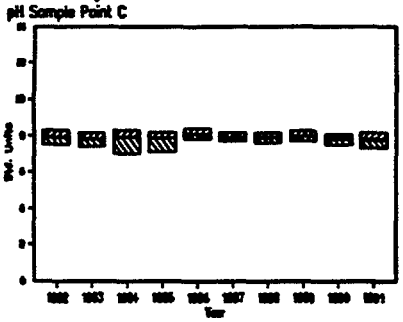
West Hackberry
pH Sample Point A



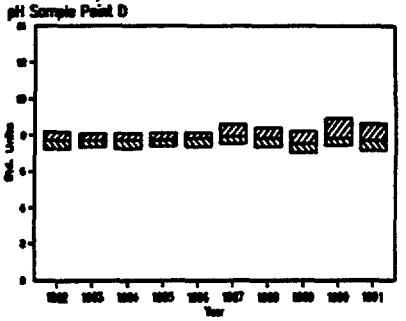
West Hackberry
pH Sample Point B



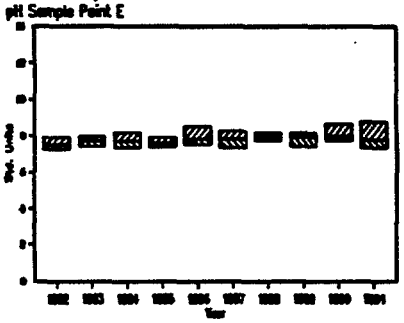
West Hackberry
pH Sample Point C



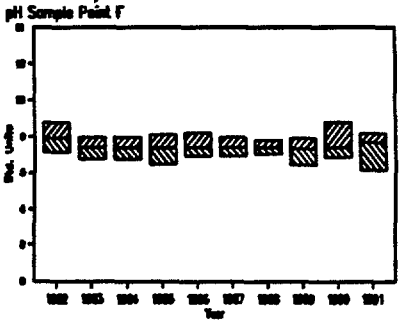
West Hackberry
pH Sample Point D



West Hackberry
pH Sample Point E

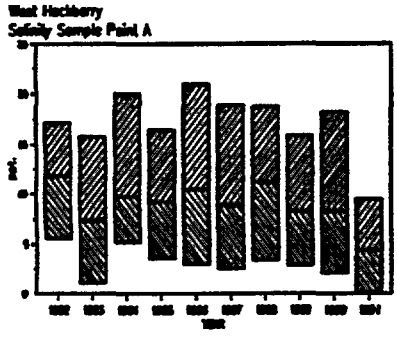


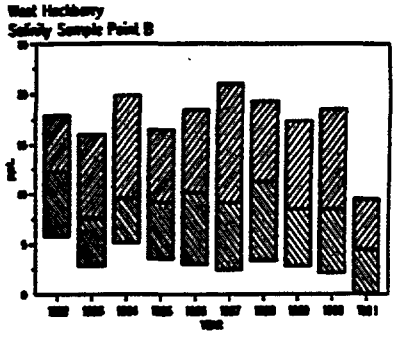
West Hackberry
pH Sample Point F

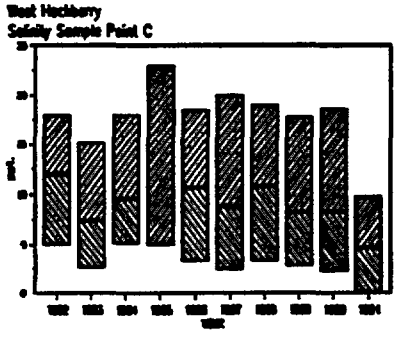


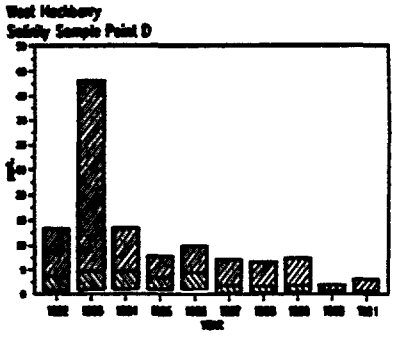
5.2.7.2 Salinity (SAL)

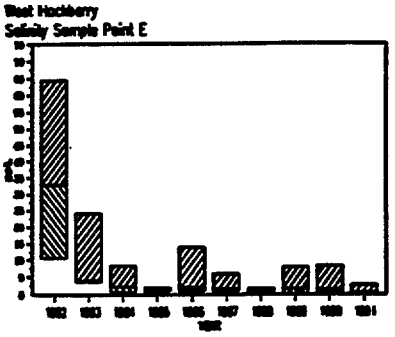
The salinity of Black Lake in 1991 exhibited a slight decline possibly attributed to tropical storms during the previous year, with all other data being consistent with previous years. Wind, tide, and rainfall contributed to the salinity variation in Black Lake. The broad salinity range observed in Black Lake is more conducive to supporting euryhaline organisms or those with sufficient mobility to avoid salinity stresses with such seasonal changes. Salinity at station D and E averaged near zero, suggesting that the brine spills did not get offsite. The wide range at station F (Intracoastal Waterway) is typical of a tidal water body.

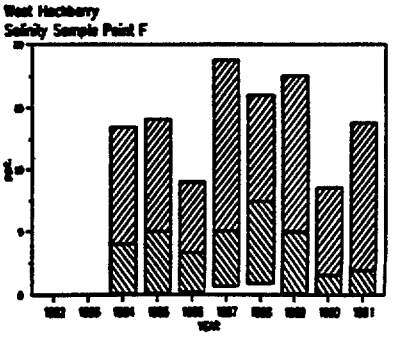






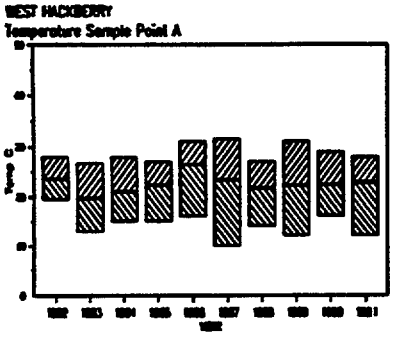


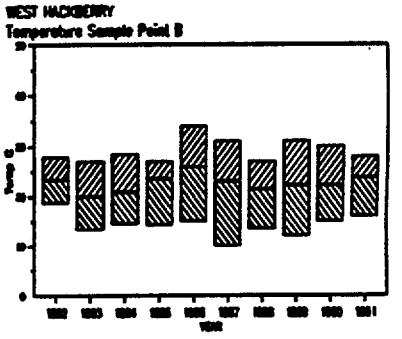


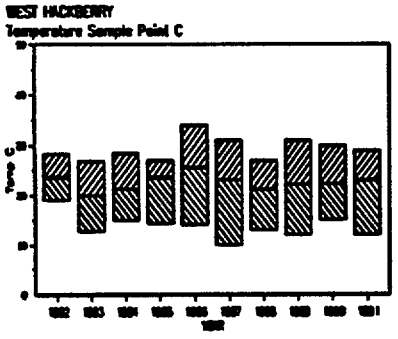


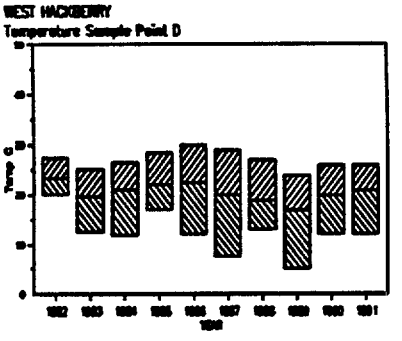
5.2.7.3 Temperature

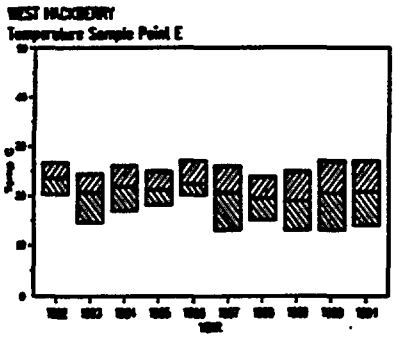
1991 data was consistent with observations at other sites indicative of regional climatic effects. No off-normal measurements were observed.

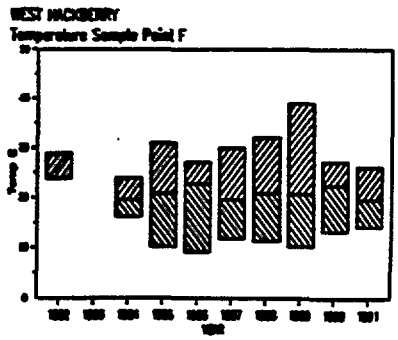






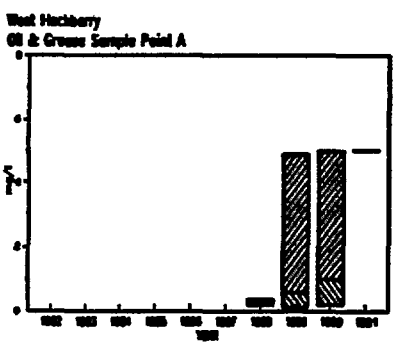


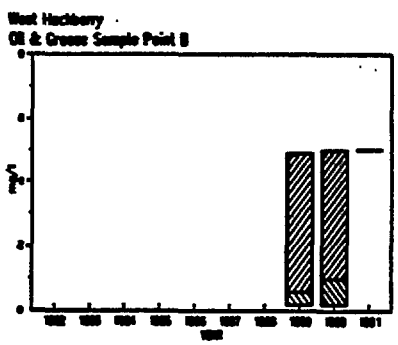


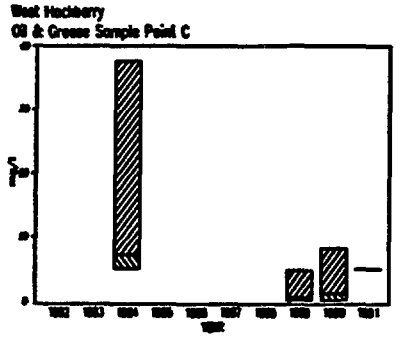


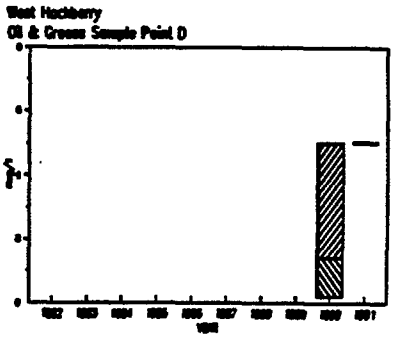
5.2.7.4 Oil and Grease

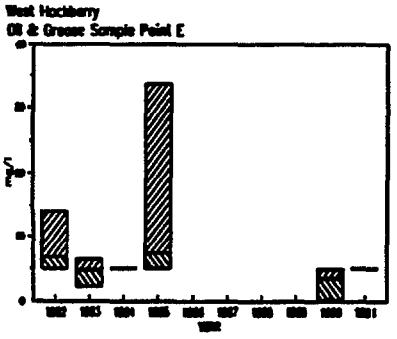
Oil and grease levels were at or below the previously detectable levels (5 mg/l) at all stations throughout 1991. New instrumentation has allowed lower detection limits, although it was not used in 1991 due to instrumentation problems. These data are generally consistent with oil and grease data collected since 1982. Data from 1988 through 1990 were analyzed using an infrared method which gives detection limits below 5 mg/l.

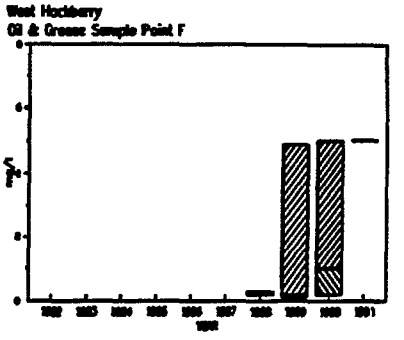










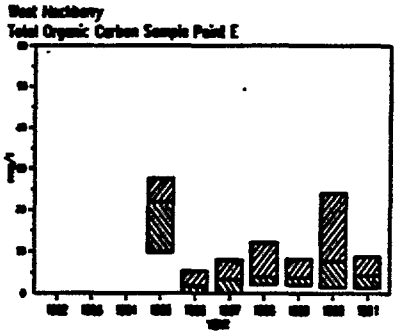


5.2.7.5 Total Suspended Solids (TSS)

TSS levels for 1991 were relatively consistent with those observed during previous years. Since the site is located in an essentially wetland/marshy area, TSS fluctuations are a natural occurrence and do not reflect site operations or influences. To limit marginally related analyses and to standardize where possible across the SPR, TSS data will no longer be generated.

5.2.7.6 Total Organic Carbon (TOC)

TOC is an NPDES permit required parameter for discharges from the high-pressure pump pad and adjacent stormwater discharges. The low levels indicate that effluent from the pad did not contribute to TOC loading in the lake.



5.2.7.7 General Observations

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

a. pH and temperature remained fairly stable and consistent with previous years.

b. Runoff from the high pressure pump pad was of lower salinity than the Black Lake receiving waters. This demonstrates continuing good control of brine leaks and spills observed since 1982.

c. Oil and grease levels were <5 mg/l in Black Lake throughout 1991.

d. TOC remained well below permit limits.

5.3 WATER DISCHARGE PERMIT MONITORING

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

SPR personnel regularly conducted point source discharges from all sites during 1991. These discharges are grouped as:

a. brine discharge to the Gulf of Mexico,
b. stormwater runoff from tank, well, and pump pads
c. rinsate produced from rinsing vehicles at specific locations draining to permitted outfalls.
d. effluent from package sewage treatment plants.

Parameters monitored varied by site and discharge. Table 5-1 identifies frequency of specific parameters measured at each SPR site. The variations in data are discussed by site.

5.3.1 Bayou Choctaw

Most 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 (STP), and stormwater runoff from well pads, pump pads (containment areas), and the site vehicle rinsing station. The outfalls are shown in Figure 5-1.

Parameters for these discharge permits are described below.

Location/Discharge	Parameter	Compliance Range
sewage treatment plants	flow	(report only)
	BOD_5	≤45 mg/l
	TSS	≤45 mg/l
	pH	6.0 - 9.0
stormwater and vehicle rinsing	flow	(report only)
	oil and grease	≤15 mg/l
	pH	6.0 - 9.0

A total of 1719 measurements were provided on permitted outfalls and reporting stations to monitor NPDES and state permit compliance during 1991. There were two noncompliances (Table 5-2) in 1991. The site had a greater than 99.9% compliance level for 1991.

Table 5-2. 1991 Noncompliances/Bypasses at Bayou Choctaw

Outfall Location	Permit Parameter	Value Limit	Cause
002	All	------	The STP was operational for a limited time early in the month, and shut down for repair. Monthly samples were not obtained for routine reporting.
001	BOD_5 (avg)	40.8 mg/l 30 mg/l	The main STP measured lower than the daily maximum for BOD_5, but above the average allowable based upon a singular data point.

5.3.2 Big Hill

Water discharges at Big Hill are regulated and enforced through the EPA NPDES permit program and the similar TWC discharge permit program (TPDES). An NPDES renewal application was submitted in 1988 as required every five years. No significant changes were requested in the application. The discharges at the facility involve brine to the Gulf of Mexico, hydroclone blowdown into the Intracoastal Waterway, effluent from the sewage treatment plant, and stormwater from well pads, pump pads, and a vehicle rinsing station. Figure 5-2 shows the existing outfalls. There were no discharges during 1991 from the hydroclone blowdown system. Parameters for all the discharges are described below. A total of 4805 measurements were provided to monitor NPDES and state discharge permit compliance during 1991. There were 15 noncompliances during 1991 (Table 5-3) resulting in a 99.7% site compliance performance level.

Location/Discharge	Parameter	Compliance Range
brine to Gulf	flow	0.27 million m^3/day
	velocity	≥ 6.1 m/sec)
	oil and grease	≤ 15 mg/l
	TDS	(report only)
	TSS	< 40 mg/l (TWC only)
	pH	6.0-9.0
	DO	detectable (when using 0_2 scavenger)
stormwater and car wash	oil and grease	≤ 15 mg/l
	TOC	≤75mg/l (EPA only)
	pH	6.0-9.0
sewage treatment plant (TWC only)	flow	< 37.8 m^3/day
	BOD_5	≤ 65 mg/l
	TSS	≤ 65 mg/l
	chlorine	1.0 - 4.0 mg/l
	pH	6.0-9.0
hydroclone blowdown (not used)	flow	report
	TSS	report
	pH	6.0-9.0

Table 5-3. 1991 Noncompliances/Bypasses at Big Hill

Outfall Location	Permit Parameter	Value Limit	Cause
003	visible sheen	-----	Oil discharged with storm water through an oil/water separator
003	By-pass	-----	Bypass was affected to avoid discharging oil sheen from non-blocked cellars
001	O&G/Holding Time	-----	Improper sample handling allowed holding time for an O&G sample to be exceeded
001	All	-----	Failure to obtain a sample of a short term flow of brine to the Gulf
003	pH	-----	A sample of storm water was discharged from the RWIS without obtaining pH (in the field)
004	pH	5.5 6.0	Low pH was measured at the STP due to natural nitrification in the equalization basin
001	DO	0.0 detectable	Oxygen scavenger was added to a brine discharge in quantities to produce no measurable oxygen at the diffusers
003	pH	-----	Storm water from the retention pond was discharged without analyzing for pH in the field (as required)

Table 5-3. 1991 Noncompliances/Bypasses at Big Hill cont.

Outfall Location	Permit Parameter	Value Limit	Cause
003	Bypass	-----	Storm water was allowed to by pass an oil/water separator, due to excessive rainfall to prevent an inadvertent release of crude oil
004	pH	5.3 6.0	The discharge from the STP was measured at 5.3. This condition results from nitrification in in the (biological) portion of the treatment process
001	All	-----	Operations personnel failed to obtain samples of a brine flow to the Gulf
004	pH	5.9 6.0	The discharge from the STP was measured at 5.9. This condition results from nitrification in the aeration basin
001	pH	0.0 detectable	Excessive oxygen scavenging resulted in oxygen depletion in a flow of brine to the Gulf
003	pH	9.1 9.0	Storm water at the RWIS was discharged without obtaining a field pH. The resulting laboratory valve exceeded permit limits
001	O&G	-----	A discharge of brine to the Gulf was not sampled for the parameter O&G - Operations personnel failed to obtain the proper sample

5.3.3 Bryan Mound

Water discharges at Bryan Mound are regulated and enforced through the EPA NPDES permit program and the similar TWC discharge permit program for state waters (TPDES). An NPDES renewal application was submitted during 1988 as required every five years. No significant changes were requested in the application. The three permitted discharges are brine to the Gulf of Mexico; stormwater from the tank farm, well pads, and pump pads; and package sewage treatment plant effluent.

Parameters and limits for the three discharges are described below.

Location/Discharge	Parameter	Compliance Range
brine to Gulf	flow	0.17 million m^3/day
(EPA only)	velocity	$\geq$ 6.1 m/sec
	oil and grease	$\leq$15 mg/l
	TDS	(report only)
	TSS	(report only)
	pH	6.0 - 9.0
stormwater	flow	(report only)
	oil and grease	$\leq$15 mg/l
	TOC	$\leq$75 mg/l (EPA only)
	pH	6.0 - 9.0
	COD	$\leq$200 mg/l (TWC only)
sewage treatment	flow	$\leq$22.7 m^3/day (TWC only)
plant	BOD_5	$\leq$45 mg/l and $\leq$0.68 kg/day
	TSS	$\leq$45 mg/l and $\leq$0.68 kg/day
	chlorine	1.0 - 4.0 mg/l
	pH	6.0 - 9.0

For the first half of 1991, the Bryan Mound facility operated in drawdown ready or standby mode. In response to the brine spill in late June (1991); the site was placed into an administratively "shut-down" mode. As a result, the site essentially operated in a minimal impact fashion for most of 1991.

A total of 2,881 measurements were provided on permitted outfalls for the purpose of monitoring NPDES and state discharge permit compliance during 1991.

There were seven noncompliances during 1991 (Table 5-4) resulting in a 99.8% site compliance performance level.

5.3.4 St. James

Outfall 001 consists of stormwater from the site retention pond. Outfalls 002 and 003 are for the two site package sewage treatment plants. All three outfalls discharge through a common pipe to the Mississippi River.

A total of 364 measurements were provided on permitted outfalls to monitor NPDES and state discharge permit compliance. There was one noncompliance in 1991 (Table 5-5) giving the site a 99.7% compliance level.

Table 5-4. 1991 Noncompliances/Bypasses at Bryan Mound

Outfall Location	Permit Parameter	Value / Limit	Cause
002	TSS	69 mg/l / 45 mg/l	Hydraulic overload from excessive rainfall entering ruptured sewer line
Storm water	TOC	-----	Storm water discharged from several pads was analyzed for TOC but the results were lost in the laboratory
Storm water	TOC	-----	Storm water samples for two discharges from the HPPP were lost or not shipped for TOC analyses at an offsite laboratory
Storm water	O&G	-----	A storm water sample aliquot for O&G analyses was lost in the laboratory when the sample glassware broke
002	BOD	90 mg/l / 45 mg/l	A sample of effluent from the STP resulted in the calculated value of 90 mg/l. The value is believed to have resulted from a failing laboratory instrument
002	Flow	7020 GPD / 6000 GPD	Excessive numbers of personnel onsite created a flow to the STP which exceeded the daily flow limit of 6000 GPD
Storm water	O&G	72.7 mg/l / 15 mg/l	A sample of stormwater from the sump on the TPP indicated a value of 72.7 mg/l for O&G. Based upon visual inspection the water was released prior to laboratory analysis

Parameters for the St. James outfalls are described below.

Location/Discharge	Parameter	Compliance Range
retention pond	flow	(report only)
	oil and grease	≤15 mg/l
	pH	6.0 - 9.0
	TOC	≤50 mg/l
sewage treatment plants	flow	(report only)
	BOD_5	≤45 mg/l
	TSS	≤45 mg/l
	pH	6.0 - 9.0

Table 5-5. 1991 Noncompliances/Bypasses at St. James Terminal

Outfall Location	Permit Parameter	Value Limit	Cause
001	O&G	-----	Improper sampling technique placed O&G samples into improper container, test results were invalidated/ unreportable

5.3.5 Sulphur Mines

The water discharge points at Sulphur Mines are regulated through the EPA NPDES program. The 1990 permit renewal regrouped the discharges. Five of the discharges are stormwater runoff from the well and pump pads. The sixth (outfall 001) is the effluent from the sewage treatment plant and the seventh (outfall 002) is from the water treatment system back flush. See Figure 5-6 for outfall locations.

Parameters for Sulphur Mines stormwater and wastewater discharges are described below.

Location/Discharge	Parameter	Compliance Range
stormwater	flow	(report only)
	oil and grease	≤15 mg/l
	pH	6.0 - 9.0
sewage treatment plant	flow	≤5.6 m^3/day
	BOD_5	<45 mg/l
	TSS	≤45 mg/l
	pH	6.0 - 9.0
water treatment system back flush	flow	(report only)
	pH	6.0 - 9.0
	salinity	(report only)

A total of 2032 measurements were provided on permitted outfalls to monitor NPDES compliance during 1991. The water system back flush was not used in 1991. There were three noncompliances during 1991 resulting in a compliance performance level of 99.9%.

Table 5-6. 1991 Noncompliances/Bypasses at Sulphur Mines

Outfall Location	Permit Parameter	Value Limit	Cause
stormwater	All	-----	A sample of Stormwater from the RWIS was taken in an improper container, thereby invalidating any test results
stormwater	pH	5.9 6.0	A sample of storm water from the HPPP was tested and discharged, despite the low value obtained in the field
stormwater	pH	-----	A sample of a stormwater discharge from a valve station was not tested in the field for pH

5.3.6 Weeks Island

The water discharges at Weeks Island are regulated and enforced in accordance with the EPA NPDES permit program and the state water discharge program (LWDPS). There are separate outfalls (01B and 002) for each package sewage treatment plant. Outfall 01A handles all of the stormwater runoff collected in an onsite retention pond (Figure 5-6). There was no discharge from the iron removal unit (outfall 003) in 1991. The water condensing unit for the mine air (outfall 004) operated continuously in 1991.

The various parameters for the monthly samples of all discharge points are listed below with their maximum limits.

Location/Discharge	Parameter	Compliance Range
stormwater	flow	(report only)
	oil and grease	≤15 mg/l
	pH	6.0 - 9.0
sewage treatment	flow	(report only)
plant	BOD_5	≤45 mg/l
	TSS	≤45 mg/l
	fecal coliforms	≤400 colonies/100 ml
	pH	6.0 - 9.0
iron removal unit	flow	(report)
	TSS	≤45 mg/l
mine air dryer	flow	(report)
condensate water	pH	6.0 - 9.0
	TOC	(report)

A total of 521 measurements were performed on permitted outfalls to monitor NPDES compliance during 1991. There were three noncompliances in 1991 (Table 5-7). The site experienced a compliance performance level of 99.4%.

Table 5-7. 1991 Noncompliances/Bypasses at Weeks Island

Outfall Location	Permit Parameter	Value Limit	Cause
01A	pH	9.4 9.0	High pH measurements resulted from naturally occurring photosynthetic processes in the retention pond
01A	Visible foam	-----	Visible foam was observed with a discharge from retention pond as a result of some AFFF being released to the pond from fire water piping repairs
01A	pH	9.1 9.0	High pH was measured with a discharge from the retention pond, which is a recurring, naturally occurring problem. Aeration has been added to the pond

5.3.7 West Hackberry

The water discharges at the West Hackberry site are regulated and enforced in accordance with the EPA NPDES permit program and LDEQs state water discharge program (LWDPS). The three categories of discharges (Figure 5-7) at West Hackberry are brine disposal to the Gulf of Mexico; sewage treatment plant effluent; and, stormwater runoff from well pads, pump pads, and vehicle rinsing. The various parameters for these discharges are listed below with their maximum limits.

Location/Discharge	Parameter	Compliance Range
brine to Gulf	flow	≤0.17 million m^3/day
	velocity	>7.6 m/sec (25 ft /sec)
	oil and grease	≤15 mg/l
	TSS	(report only)
	TDS	(report only)
	pH	6.0 - 9.0
	DO	detectable (when using O_2 scavenger)
sewage treatment plant	flow	(report only)
	BOD_5	≤15 mg/l
	TSS	≤45 mg/l
	fecal coliform	(report only)
	pH	6.0 - 9.0
stormwater	flow	(report only)
	oil and grease	≤15 mg/l
	TOC	≤75 mg/l
	pH	6.0 - 9.0

A total of 5376 measurements were performed on permitted outfalls to monitor NPDES compliance during 1991. Permit noncompliances were identified on three occasions (Table 5-8). These three noncompliances, on a per analysis basis, resulted in a site compliance performance level of 99.9%.

Table 5-8. 1991 Noncompliances/Bypasses at West Hackberry

Outfall Location	Permit Parameter	Value Limit	Cause
001	pH	-----	Monthly measurement for pH was not obtained on a singular flow of brine to the gulf
Stormwater	Bypass	-----	Due to excessive overnight rainfall; the oil/water separator was bypassed in order to prevent the retention pond from overflowing
001	All	-----	Operations personnel failed to obtain samples on a brine flow to the Gulf

5.4 ENVIRONMENTAL PERMITS

The active environmental permits, required by regulatory agencies to construct, operate and maintain the SPR, are discussed by site.

5.4.1 Bayou Choctaw

Table 5-9 lists the active permits at Bayou Choctaw. Individual work permits are received from the Louisiana Underground Injection Control Division for each well workover performed. State inspectors regularly visit the site to observe SPR operations.

5.4.2 Big Hill

Table 5-10 lists the active permits at Big Hill. The Big Hill site has a modified an amendment to its TWC permit for appropriating additional state waters for the leaching, site utility, and fire protection systems. The permit requires a yearly report of water quantities used. In 1991, the site appropriated 76.7 million m^3 (15,220 acre-feet) of water from the Intracoastal Waterway exclusive of water for fire protection. This represents 13% of the total allowable withdrawal for a year.

Table 5-9

Active Permits at Bayou Choctaw

PERMIT NUMBER	ISSUING* AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0053040	EPA	NPDES	3/13/83	3/12/88	(1)
WP0179	LDEQ	Water (Disch.)	7/22/83	7/21/88	(5)
1280-00015-000	LDEQ	Air	10/01/87	Open	
None	LDNR	Injection	1/11/83	Open	(2)
SDS-1	LDNR	Injection	9/09/77	Open	(8)
LMNOD-SP (Bayou Plaquemine)17	COE	Maint.	9/26/77	9/26/87	(3),(7)
LMNOD-SP (Bull Bay)3	COE	Constr. Maint.	1/30/79 1/30/79	1/29/82 9/26/87	(4),(6) (7)
LMNOD-SP (Iberville Parish Wetlands)7	COE	Constr. & Maintain	9/26/77	-	(9)
LMNOD-SP (Iberville Parish Wetlands)10	COE	Constr. & Maintain	6/12/78	-	(10)
LMNOD-SP (Iberville Parish Wetlands)17	COE	Constr. & Maintain	11/6/78	-	(11)
LMNOD-SP (Iberville Parish Wetlands)31	COE	Constr. & Maintain	5/27/80	-	(12)
LMNOD-SP (Iberville Parish Wetlands)102	COE	Constr. & Maintain	9/26/77	-	(13)

(1) Renewal submitted (11/9/87 and letter to DOE of January 31, 1991 addresses status).

(2) Letter of financial responsibility to plug and abandon injection wells.

(3) Maintain 36-inch crude oil pipeline.

(4) Maintain Bull Bay 24" brine disposal pipeline.

(5) No response from LDEQ. Application resubmitted. Follow-up submission 10/92

(6) Recorded with applicable Registrar of Deeds.

(7) Maintenance clause of permit is being renewed.

(8) Permit approved use of salt dome cavities for storage of liquid hydrocarbons.

(9) Construct and maintain well pads (brine disposal wells).

(10) Enlarge existing well pads and construct access roads (brine disposal Wells 1, 2, & 3.)

(11) Construct and maintain access road to brine disposal well area.

(12) Construct and maintain well pad, levees, access road & appurtances cavern 102 and additional bank stabilization, warehouse pad and culvert per additions of 1983.

(13) Construct and maintain ring levee, drill site and appurtenances, Well 101.

* COE - U.S. Army Corps of Engineers
EPA - Environmental Protection Agency
LDEQ - Louisiana Department of Environmental Quality
LDNR - Louisiana Department of Natural Resources

Table 5-10. Active Permits at Big Hill

PERMIT NUMBER	ISSUING* AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
TX0092827	EPA	NPDES	01/18/89	01/17/94	(1)
SWGCO-RP 16536 (01,02,03)	COE	Constr. & Maint.	01/11/84 01/11/84	1/11/94	(10)
P-7	F&WS	Constr. Operate	07/31/86 07/31/86	07/31/88 06/30/36	(3)
9256	TACB	Air	05/17/83	5/16/98	(4)
02937-02939	RCT	Operate	11/28/83	Open	(5)
P000226A-P000226B	RCT	Operate/ Maintain	09/19/84	Open	(9)
0048295-0048320	RCT	Operate	05/09/83 06/23/83	Open Open	(6)
02638	TWC	Water (Disch.)	03/27/89	03/26/94	(7)
4045A	TWC	Water (Use)	11/14/83	Open	(8)

5.4.3 Bryan Mound

Table 5-11 lists the active permits for the Bryan Mound site. 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 1991, the site did not appropriate water from the Brazos River Diversion Channel. A total of 146.96 million m^3 (119,142 acre-feet) of water has been appropriated to date for site activities which represents 32.4% of the total volume permitted.

5.4.4 St. James

Table 5-12 lists the active permits at St. James Terminal.

5.4.5 Sulphur Mines

Table 5-13 lists the active permits at Sulphur Mines. All state underground injection control certifications are current. State inspectors regularly visit the site to observe underground injection operations.

5.4.6 Weeks Island

The active permits for Weeks Island are listed in Table 5-14.

5.4.7 West Hackberry

Active permits for West Hackberry are listed in Table 5-15.

(1) Renewal submitted 10-23-88. Accepted as administratively complete.

(2) Completion of raw water, brine disposal, and crude oil pipeline extended. Amended to install offshore pipeline by trenching.

(3) Completion of pipeline construction extended. (48" Brine Pipeline)

(4) Issued as C-9256 initially.

(5) Valid until ownership changes, system changes, or other physical changes are made in the system.

(6) Permits to create, operate, and maintain an underground hydrocarbon storage facility consisting of 14 caverns.

(7) Corresponds to TX0092827. (EPA-NPDES)

(8) Permit expires after consumption of 239,080 acre-feet of water or end of project.

(9) Permits to operate and maintain anhydrite and brine/oil pits.

(10) Permits to construct and maintain RWIS, raw water 48" pipeline, brine disposal 48" pipeline, crude oil 36" pipeline

* F&WS - U.S. Fish and Wildlife Service

RCT - Railroad Commission of Texas

TACB - Texas Air Control Board

TWC - Texas Water Commission

Table 5-11. Active Permits at Bryan Mound

PERMIT NUMBER	ISSUING* AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
TX0074012	EPA	NPDES	02/02/89	02/01/94	(1)
SWGCO-RP-12347(01)	COE	Dredging	02/29/84	12/31/94	(2)
3-67-782 (Docket#)	RCT	Injection	08/21/78	Open	(3)
P001447	RCT	Operate	10/30/84	Open	(5)
P001448	RCT	Operate	10/30/84	Closed	(4)
3-70-377 (Docket#)	RCT	Injection	12/18/78	Open	(3)
3681A	TWC	Water	07/20/81	Open	(6)
02271	TWC	Water	02/05/90	02/04/95	(7)
6176B	TACB	Air	02/23/87	02/22/02	
82-8475	TDH&PT	Constr.	01/01/83	Open	(8)
SWGCO-RP 11666	COE	Constr. & Maint.	10/15/77	-	(9)
SWGCO-RP 12112	COE	Constr. & Maint.	7/25/77	-	(10)
SWGCO-RP 12062	COE	Constr. & Maint.	10/10/78	-	(11)
SWGCO-RP 14114 (01)	COE	Constr. & Maint.	5/18/85	-	(12)
SWGCO-RP 16177	COE	Constr. & Maint.	9/7/82	-	(13)

(1) Renewal submitted 9/7/88. Accepted as administratively complete.

(2) Maintenance dredging of raw water intake extended. (SWGCO-RP 12347 authorized constr. of RWIS)

(3) Approval of oil storage and salt disposal program.

(4) Small brine pond closed August, 1989.

(5) Authority to operate brine pond.

(6) Permit expires after consumption of 367,088 acre-feet of water or project ends.

(7) Corresponds with TX0074012 (EPA-NPDES). (Renewal submitted 1/30/89, RCT presently reviewing)

(8) Corresponds with SWGCO-RP-16177.

(9) for 30-inch crude oil pipeline to 3 miles SW from Freeport

(10) for 30-inch crude oil pipeline to 2 miles S from Freeport

(11) for 36-inch brine disposal pipeline & diffuser (revision 01 in process)

(12) general permit for pipeline crossings by directional drilling in navigable waters

(13) place an 8-inch water line (PVC, potable)

* TDH&PT - Texas Department of Highways and Public Transportation

Table 5-12. Active Permits at St. James Terminal

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0054674	EPA	NPDES	07/11/90	07/10/95	(4)
LMNOD-SP (Mississippi River) 998	COE	Maint.	03/20/78	03/20/88	(1)
WP 0929	LDEQ	Water (Disch.)	05/04/90	05/03/95	(3)
983	LDEQ	Air	07/25/78	Open	(2)

(1) Permit and all amendments recorded with Registrar of Deeds in St. James Parish.

(2) Requires annual operating report. (EIQ and permit being revised.)

(3) LDEQ Water Permit renewal submitted.

(4) Permit renewal submitted May 25, 1990. Accepted as administratively complete

Table 5-13. Active Permits at Sulphur Mines

PERMIT NUMBER	ISSUING* AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LMNOD-SP (LTCS)20	COE	Maint.	07/24/78	Open	(1)
LA0055786	EPA	NPDES	04/12/90	04/11/95	(2)
NONE	LDEQ	Water (Disch.)	12/07/84	Open	(7)
1042	LDEQ	Air	09/26/78	Open	(3)
None	LDOTD	Water (Use)	01/01/90	12/31/90	(4)
None	LDNR	Brine Injection	01/11/83	Open	(5)
SDS-6	LDNR	Brine Injection	07/20/78	Open	(6)

(1) Renewal submitted 8/13/85 for erosion control work on the Intracoastal Waterway. Recorded permit and amendments with applicable Parish Registrars of Deeds.

(2) Third round renewal submitted April 12, 1990. Accepted as administratively complete. (resubmission to LDEQ for Oct. 1992)

(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.

(7) Permit submitted to LDEQ. State never responded. EPA NPDES renewal notification sent to LDEQ. Still no response from state.

* LDOTD - Louisiana Department of Transportation and Development

Table 5-14. Active Permits at Weeks Island

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0056243	EPA	NPDES	10/14/87	10/13/92	(1)
LMNOD-SP (Atchafalaya Floodway) 251	COE	Constr. Maint.	07/12/78	07/11/88	(2)
1105	LDEQ	Air	01/30/79	Open	(3)
SDS-8	LDNR	Injection	02/16/79	Open	(4)
WP1051	LDEQ	Water (Disch.)	01/17/87	1/16/92	(5)

(1) Renewal submitted 9/25/87. Accepted as administratively complete. (renewal anticipated for CY 1993)

(2) Recorded permit and amendments with applicable Parish Registrar of Deeds. Maintenance clause being renewed.

(3) Requires annual operating report.

(4) Approval for use of salt dome cavities for storage of liquid hydrocarbons.

(5) Permit interpereted to expire 1/16/93 via LAC; renewal being submitted for June 1992.

Table 5-15

Active Permits at West Hackberry

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0053031	EPA	NPDES	08/22/89	08/21/94	(8)
LMNOD-SP (LTCS)26	COE	Dredging	02/08/79	02/08/99	(1)
LMNOD-SP (Black Lk)31	COE	Dredging	10/26/82	05/15/97	(2)
LMNOD-SP (Black Lk)43	COE	Constr. Maint.	07/26/84 07/26/94	07/25/87 Open	(3)
LMNOD-SP (Gulf of Mexico)2574	COE	Constr. Maint.	08/11/80 08/11/80	08/11/90 Open	(4)
LMNOD-SE (LTCS)40	COE	Constr. Maint.	05/25/88 05/25/88	06/30/91 Open	(10)
LMNOD-SP (Cameron Parish Wetlands)162	COE	Maint.	03/09/78	03/09/88	(11)
None	LDNR	Injection	08/07/79	Open	(5)
971198-9	LDNR	Injection	10/06/83	Open	(6)
WP1892	LDEQ	Water (Disch.)	12/08/88	12/09/93	(8) (9)
1048	LDEQ	Air	10/26/78	Open	(7)
SWGCO-RP-12342	COE	Constr. & Maint.	3/28/78	-	(12)
LMNOD-SP (Cameron Parish Wetlands) 152		Constr. & Maint.	3/16/78	-	(13)
LMNOD-SP (Cameron Parish Wetlands)276		Constr. & Maint.	2/11/80	-	(14)

(1) Maintenance dredging for raw water intake.

(2) Maintenance dredging for fire water canal.

(3) Maintenance of erosion control dike completed in 1986.

(4) Amended to install parallel pipeline (05/29/86).

(5) Approval to create 16 additional salt dome cavities.

(6) Approval to construct and operate wells 117A and B.

(7) Requires semi-annual status-of-construction report.

(8) Renewal submitted 4/6/89. Dates based on previous permit. Accepted as administratively complete

(9) Includes Texoma/Lake Charles Meter Station-Outfall 004.

(10) Permit to construct and maintain 36" crude oil pipeline from site to Texoma/LC Meter Station.

(11) Permit to maintain 42" crude oil pipeline.

(12) For 42" crude oil pipeline crossings of waters & waterways

(13) For brine disposal wells, well pads, and brine disposal pipelines, (12", 20", & 24")

(14) For well pads, levees, and access roads (Wells 110, 111, 112, 113, 114, & 115)

5.5 SARA TITLE III REPORTING REQUIREMENTS

To fulfill requirements set forth in the Emergency Planning and Community Right-To-Know Act of 1986, the SPR submitted SARA Title III Tier Two forms for 1991, for each site. All sites reduced the number of reportable chemicals onsite compared with 1990 reports. Tables 5-16 through 5-24 list chemical name, range value (lbs), and location of hazardous chemicals on the SPR above Threshold Planning Quantity (TPQ). No extremely hazardous substances were found on the SPR above the TPQ or the release Reportable Quantity (RQ). No hazardous or extremely hazardous substance release occurred on the SPR in 1991.

Table 5-16.

QUANTITIES/LOCATIONS OF HAZARDOUS SUBSTANCES/CHEMICALS AT BAYOU CHOCTAW

Chemical Name/Category	Amount lbs		Location
	Max Daily	Avg. Daily	
AFFF, (butylcarbitol) fire systems foam	10,000 - 99,999	10,000 - 99,999	Foam deluge bldg & stg. bldg
Ammonium Bisulfite	1,000 - 9,999	1,000 - 9,999	Adj to brine pond
Bromotrifluoromethane (Halon 1301)	1,000 - 9,999	1,000 - 9,999	Control room in ops bldg
Compound Rust Preventing or Rust Removing	100 - 999	100 - 999	Maintenance Laydown Yard & Tool Room
Crude Oil, Petroleum flammable and combustible liquid	100,000,000 - 499,999,999	100,000,000 - 499,999,999	Offsite pipeline in Iberville Parish, LA
Crude Oil, Petroleum flammable and combustible liquid	1 billion > 1 billion	1 billion > 1 billion	Six underground storage caverns in salt dome & site piping
Diesel Fuel	10,000 - 99,999	10,000 - 99,999	Fuel stn, flood pump & generators near SW exit water pumps near NW entrance
Gasoline	10,000 - 99,999	1,000 - 9,999	Fuel stn near SW exit emergency generator at disposal wells
Hazardous Waste, liquid or solid, N.O.S.	1,000 - 9,999	100 - 999	Laydown yard and satellite areas
Hydrochloric Acid, Mixture (HCl,HF)	10,000 - 99,999	100 - 999	Disposal wells
Paint, Flammable or Combustible	1,000 - 9,999	1,000 - 9,999	Flammable stg bldg & maint bldg
Visco 1152 Biocide	10,000 - 99,999	1,000 - 9,999	Pig trap at NE corner of site

Table 5-17.

QUANTITIES/LOCATIONS OF HAZARDOUS SUBSTANCES/CHEMICALS AT BIG HILL

Chemical Name/Category	Amount lbs*		Location
	Max Daily	Avg. Daily	
Ammonium Bisulfite	10,000 - 99,999	10,000 - 99,999	Near brine pond
AFFF, (butylcarbitol)	10,000 - 99,999	10,000 - 99,999	Drum stg in laydown yard, Fire systems at/near pump pads
Bromotrifluoromethane (Halon 1301)	1,000 - 9,999	1,000 - 9,999	Control bldg, control room, RWIS
Crude oil, petroleum, flammable and combustible liquid	10,000 - 49,000	10,000 - 49,000	Offsite pipelines in Jefferson County, TX
Crude oil, petroleum, flammable and combustible liquid	1 billion - 1 billion	1 billion - 1 billion	Tanks, piping & underground stg caverns across the salt dome
Diesel Fuel	10,000 - 99,999	10,000 - 99,999	Fuel stn & RWIS
Gasoline, including casing-head and natural (a volatile blend)	10,000 - 99,999	1,000 - 9,999	Fuel stn
Oil, Flammable and Combustible	1,000 - 9,999	1,000 - 9,999	Warehouse, lab & RWIS
Paint, Flammable or Combustible	1,000 - 9,999	1,000 - 9,999	Laydown yard, RWIS, lab & warehouse
Solvents and thinners flammable and combustible	100 - 999	100 - 999	Flammable storage in laydown area, warehouse, and intake structure

Table 5-18.

QUANTITIES/LOCATIONS OF HAZARDOUS SUBSTANCES/CHEMICALS AT BRYAN MOUND

Chemical Name/Category	Amount lbs		Location
	Max Daily	Avg. Daily	
1,1,1-Trichloroethane	1,000 - 9,999	1,000 - 9,999	Laydown yard, flammable stg bldg, warehouse bldg & tool room
AFFF (butylcarbitol)	10,000 - 99,999	10,000 - 99,999	Fire systems throughout site, foam bldg, laydown yard, & excess yard
Bromotrifluoromethane (Halon 1301)	1,000 - 9,999	1,000 - 9,999	Control room, motor control center
Calgon, cat-floc and polymer	1,000 - 9,999	1,000 - 9,999	Laydown yard & pump pad
Carbethoxy malathion insecticide	1,000 - 9,999	100 - 999	Laydown yard, flammable stg bldg & tool room
Crude oil, petroleum, flammable and combustible liquid	50,000,000 - 99,999,999	50,000,000 - 99,999,999	Offsite pipelines in Brazoria County, TX
Crude Oil, petroleum, flammable and combustible liquid	1 billion > 1 billion	1 billion > 1 billion	Tanks, piping, & underground stg caverns across the salt dome
Diesel Fuel	10,000 - 99,999	10,000 - 99,999	Fuel stn and RWIS
Gasoline - including casing-head and natural (a volatile blend)	10,000 - 99,999	10,000 - 99,999	Fuel stn
Hazardous Waste liquid or solid, N.O.S.	100 - 999	0 - 99	Laydown yard & satellite stg
Oil, flammable and combustible	1,000 - 9,999	100 - 9,999	Laydown yard, flammable stg bldg, & warehouse
Paints, flammable or Combustible	1,000 - 9,999	1,000 - 9,999	Flammable stg bldg

Table 5-19.

QUANTITIES/LOCATIONS OF HAZARDOUS SUBSTANCES/CHEMICALS AT NEW ORLEANS

Chemical Name/Category	Amount lbs		Location
	Max Daily	Avg. Daily	
Alkaline, liquid	1,000 - 9,999	1,000 - 9,999	Warehouse and Elmwood Complex Bldg. Graphic Arts
Compound, Cleaning Liquid, Flammable Liquid	100 - 999	100 - 999	Warehouse Elmwood complex bldgs, & graphic arts in 850 bldg

Table 5-20.

QUANTITIES/LOCATIONS OF HAZARDOUS SUBSTANCES/CHEMICALS AT ST. JAMES TERMINAL

Chemical Name/Category	Amount lbs		Location
	Max Daily	Avg. Daily	
AFFF (butylcarbitol)	10,000 - 99,999	10,000 - 99,999	Containers in fire truck bay, Fire systems on main site and dock
Bromotrifluoromethane (Halon 1301)	100 - 999	100 - 999	Control room in OPS bldg
Compound, tree or weed killing, liquid poison B	1,000 - 9,999	100-999	Laydown area
Compressed gas (except helium, neon, argon, krypton, xenon)	100 - 999	100 - 999	Lab, meter stn, inside & outside of OPS bldg
Crude oil, petroleum flammable and combustible liquid	10,000,000 - 49,999,999	10,000,000 - 49,999,999	Offsite pipelines in St. James Parish, LA
Crude oil, petroleum flammable and combustible liquid	100,000,000 - 499,999,999	100,000,000 - 499,999,999	Six large tanks, onsite piping & sumps

Table 5-20 cont.

Chemical Name/Category	Amount lbs		Location
	Max Daily	Avg. Daily	
Diesel Fuel	10,000 - 99,999	10,000 - 99,999	Fuel stn in laydown area, dock fire pumps, emergency generators along south site fence & fire pump near fuel stn
Gasoline	10,000 - 99,999	1,000 - 9,999	Fuel stn in laydown area
Hazardous Waste, liquid or solid N.O.S.	1,000 - 9,999	0 - 99	Laydown yard & satellite areas
Oil, Flammable and Combustible	1,000 - 9,999	1,000 - 9,999	Flammable stg bldg, lab, flammable cabinet OPS bldg
Paint, Flammable or Combustible	1,000 - 9,999	1,000 - 9,999	Flammable stg bldg, & paint shed near laydown area
Propane or Liquified petroleum gas supplied as pressurized	1,000 - 9,999	1,000 - 9,999	Lab, fire pumps, flammable stg near laydown area
Visco 1152 Biocide	1,000 - 9,999	1,000 - 9,999	West end main site

Table 5-21

QUANTITIES/LOCATIONS OF HAZARDOUS SUBSTANCES/CHEMICALS AT SULPHUR MINES

Chemical Name/Category	Amount lbs		Location
	Max Daily	Avg. Daily	
AFFF (butylcarbitol)	10,000, - 99,999	10,000 - 99,999	Laydown yard drum stg
Bromotrifluoromethane (Halon 1301)	100 - 999	100 - 999	Primary site area control room
Crude oil, petroleum flammable and combustible liquid	50,000,000 - 99,999,999	50,000,000 - 99,999,999	Offsite pipelines in Calcasieu Parish, LA
Crude oil, petroleum flammable and combustible liquid	1 billion > 1 billion	1 billion > 1 billion	Underground stg caverns in salt dome & site piping
Diesel Fuel	10,000 - 99,999	10,000 - 99,999	Primary site flammable stg area & fuel stn, secondary site firewater pumps, RWIS
Gasoline	10,000 - 99,999	1,000 - 9,999	Primary site area fuel stn
Oil, flammable and combustible	1,000 - 9,999	1,000 - 9,999	Primary site drum stg area & paint shed
Paint, flammable or area combustible	1,000 - 9,999	1,000 - 9,999	Primary site paint shed
Propane or liquified motor petroleum gas supplied as pressurized	10,000 - 99,999	1,000 - 9,999	Primary site control center secondary site subsidence area
Visco 1152 Biocide	1,000 - 9,999	1,000 - 9,999	Primary site area meter skid

Table 5-22.

QUANTITIES/LOCATIONS OF HAZARDOUS SUBSTANCES/CHEMICALS AT WEEKS ISLAND

Chemical Name/Category	Amount lbs		Location
	Max Daily	Avg. Daily	
AFFF (butylcarbitol) foam	10,000 - 99,999	10,000 - 99,999	Fire equipment & maint bldg & stg bldg
Ammonium Nitrate Fertilizer	100 - 999	100 - 999	Laydown area
Antifreeze Compound, Liquid	1,000 - 9,999	1,000 - 9,999	Laydown area
Battery Fluid, Acid	1,000 - 9,999	1,000 - 9,999	Warehouse
Bromotrifluoromethane (Halon 1301)	10,000 - 99,999	10,000 - 99,999	Control room in OPS bldg, mine service shaft
Compressed gases, N.O.S., flammable and nonflammable (excluding propane)	1,000 - 9,999	1,000 - 9,999	Laydown area flammable stg bldg
Crude Oil, petroleum flammable and combustible liquid	1,000,000 - 9,999,999	1,000,000- 9,999,999	Offsite pipeline in Iberia Parish, LA
Crude Oil, petroleum and combustible liquid	1 billion > 1 billion	1 billion > 1 billion	Underground storage cavern in salt dome & site piping
Diesel Fuel	10,000 - 99,999	10,000- 99,999	Fuel stn in laydown area, fire water stg area, production shaft area, & main site near emergency generator
Gasoline	10,000 - 99,999	10,000 - 99,999	Fuel station in laydown area
Hazardous Waste, liquid or solid, N.O.S.	100 - 999	0 - 99	Laydown yard & satellite areas
Insecticide, Liquid, N.O.S.	1,000 - 9,999	1,000 - 9,999	Laydown area, flammable storage bldg.
Oil, Flammable and Combustible	1,000 - 9,999	1,000 - 9,999	Laydown area, flammable storage, bldg
Paint, Flammable and Combustible	100 - 999	100 - 999	Laydown area paint shed & flammable stg bldg
Phosphoric Acid	100 - 999	100 - 999	Laydown area drum rack & shed
Visco 1152 Biocide	1,000 - 9,999	1,000 - 9,999	Laydown Area

Table 5-23.

QUANTITIES/LOCATIONS OF HAZARDOUS SUBSTANCES/CHEMICALS AT WEST HACKBERRY

Chemical Name/Category	Amount lbs		Location
	Max Daily	Avg. Daily	
1,1,1-Trichloroethane	100 - 999	100-999	Warehouse & flammable stg bldg
AFFF (butylcarbitol)	10,000 - 99,999	10,000 - 99,999	Foam stg bldg, (site fire systems)
Ammonium bisulfite, solution	10,000 - 99,999	10,000 - 99,999	West of brine pond
Antifreeze compound, liquid	1,000 - 9,999	100 - 999	Property yard
Bromotrifluoromethane (Halon 1301)	1,000 - 9,999	1,000 - 9,999	Control room & lab
Coal Tar, Naphtha Flammable Liquid	100 - 999	0 - 99	Flammable Storage Bldg.
Compound, Rust Preventing or Rust Removing	100 - 999	100 - 999	Site warehouse & and flammable stg bldg.
Crude oil, petroleum, Flammable and Combustible liquid	10,000,000 - 49,999,999	10,000,000 - 49,999,999	Offsite pipeline in Cameron Parish, LA
Crude oil, petroleum, flammable and combustible liquid	1 billion > 1 billion	1 billion > 1 billion	Underground storage caverns in salt dome & site piping
Diesel Fuel	10,000 - 99,999	1,000 - 9,999	Site fuel stn, & workover yard
Gasoline	10,000 - 99,999	10,000 - 99,999	Site fuel stn
Hazardous Waste, liquid or solid, N.O.S.	1,000 - 9,999	100 - 999	Laydown yard & satellite areas
Oil, Flammable and Combustible	1,000 - 9,999	1,000 - 9,999	Warehouse, property yard, & flammable stg bldg
Paint, Flammable or Combustible	1,000 - 9,999	1,000 - 9,999	Flammable storage & warehouse bldgs
Propane or Liquefied	10,000 - 99,999	10,000 - 99,999	Maint bldg, motor
Petroleum Gas supplied as pressurized	10,000 - 99,999	10,000 99,999	control center, & site fire training area

Table 5-24.

QUANTITIES/LOCATIONS OF HAZARDOUS SUBSTANCES/CHEMICALS IN OFFSITE PIPELINES

Chemical Name/Category	Amount lbs		Location
	Max Daily	Avg. Daily	
Crude Oil, Petroleum, flammable and combustible liquid	10,000,000-49,999,999	10,000,000 - 49,999,999	Offsite pipelines in St. Martin Parish, LA
Crude Oil, Petroleum, flammable and combustible liquid	50,000,000-99,999,999	10,000,000 - 49,999,999	Offsite pipeline in Assumption Parish, LA
Crude Oil, Petroleum, flammable and combustible liquid	1,000,000-9,999,999	1,000,000 - 9,999,999	Offsite pipeline in Ascension Parish, LA
Crude Oil, Petroleum, flammable and combustible liquid	10,000,000-49,999,999	10,000,000 - 49,999,999	Offsite pipeline in St. Mary Parish, LA
Crude Oil, Petroleum, flammable and combustible liquid	10,000,000-49,999,999	10,000,000 - 49,999,999	Offsite pipeline in Galveston County, TX
Crude Oil, Petroleum, flammable and combustible liquid	10,000,000-49,999,999	10,000,000 - 49,999,999	Offsite pipeline in Orange County, TX

Adj - Adjacent
AFFF - Aqueous Film Forming Foam
avg - average
bldg - building
lbs - pounds
maint - maintenance
max - maximum
NE - northeast
NW - northwest
ops - operations
stn - station
SW - southwest
lab - laboratory
RWIS - raw water intake structure

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6. HYDROLOGY AND GROUND WATER MONITORING

Ground water monitoring is performed at Bayou Choctaw, Big Hill, Bryan Mound, and West Hackberry. Salinities are monitored although ground water monitoring is not required by any Federal or state regulations or permits.

West Hackberry ground water recovery activities, including the installation of additional recovery and monitoring wells, were reported monthly to the Louisiana Department of Natural Resources in 1991. Salinity and flow data from newly installed recovery and monitoring wells will be reported to the state quarterly in 1992.

Background information is not available on the construction and installation of some of the existing monitoring wells at Bryan Mound and West Hackberry, which limits the ability to interpret data. The ground water characteristics of each site are discussed within each site section.

6.1 BAYOU CHOCTAW

The Plaquemine Aquifer is the main source of fresh water for the site and several surrounding municipalities. It is located approximately 18 m (60 ft) below the surface and extends to a depth of 150 to 182 m (500-600 ft). The upper 18 m (60 ft) of sediments in the aquifer consist of predominantly Atchafalaya clay. The interface of freshwater and saline water occurs at a depth of 122 to 150 m (400-500 ft) below the surface. Ground water in the Plaquemine Aquifer communicates with the Mississippi River, flowing away from it during the high river stage and towards the river in the low stage.

Three monitoring wells (MW1, 2, and 3) were installed at the Bayou Choctaw facility in September 1989, and a fourth (MW4) in 1990. These wells were drilled to monitor the brine pond and not the Plaquemine Aquifer (Figure 6-1).

BAYOU CHOCTAW

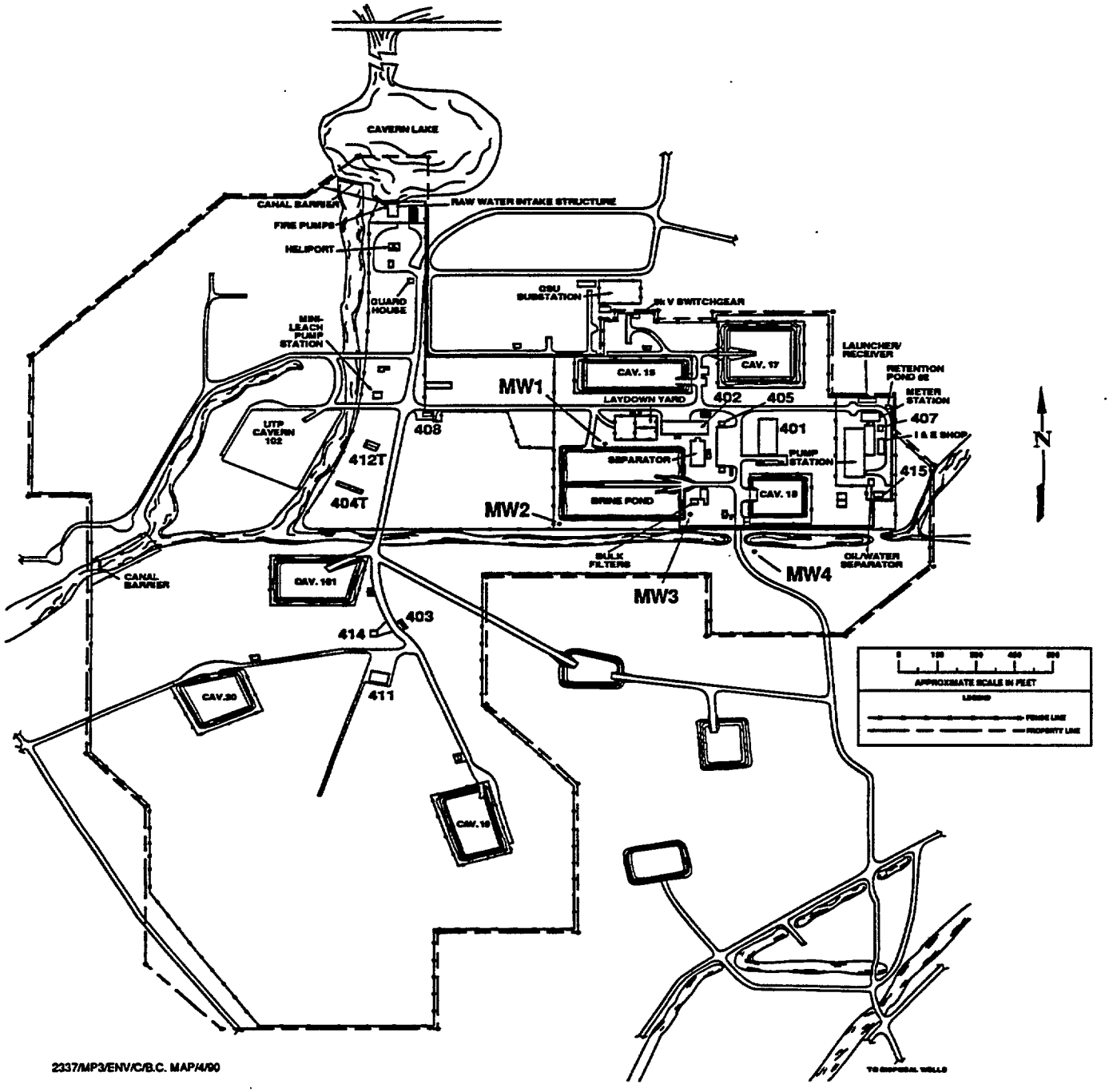
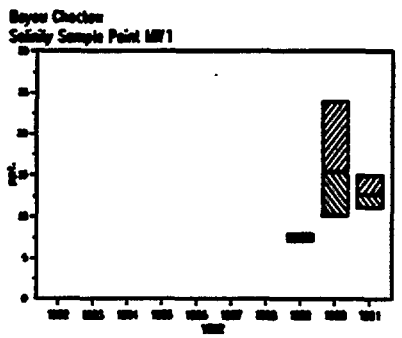
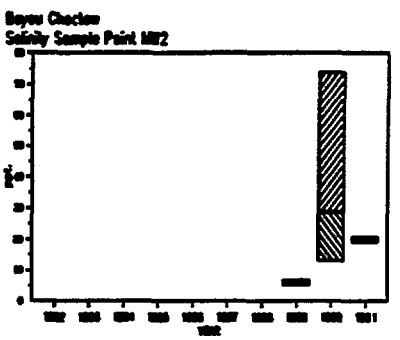


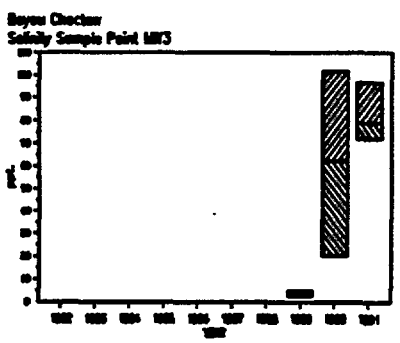
Fig. 6-1
Bayou Choctaw Groundwater Monitoring Wells

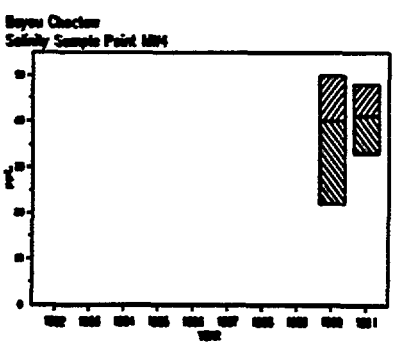
Salinities increased substantially at MW1, 2, and 3 in 1990, but decreased slightly at MW1 and 2 in 1991. Salinities at MW3 continued to increase in 1991. Salinity readings were more consistent from month to month in 1991 than in 1990. Sampling of MW4 began late in 1990, but salinity did not change appreciably in 1991.

There were no known buried brine pipe leaks or brine spills around the brine pond in 1991 that could have affected ground water salinity, assuming ground water flow across the site continued in an east-west direction. Future ground water data and on-going inspections of the brine pond and piping will assist in determining if leakage does exist.









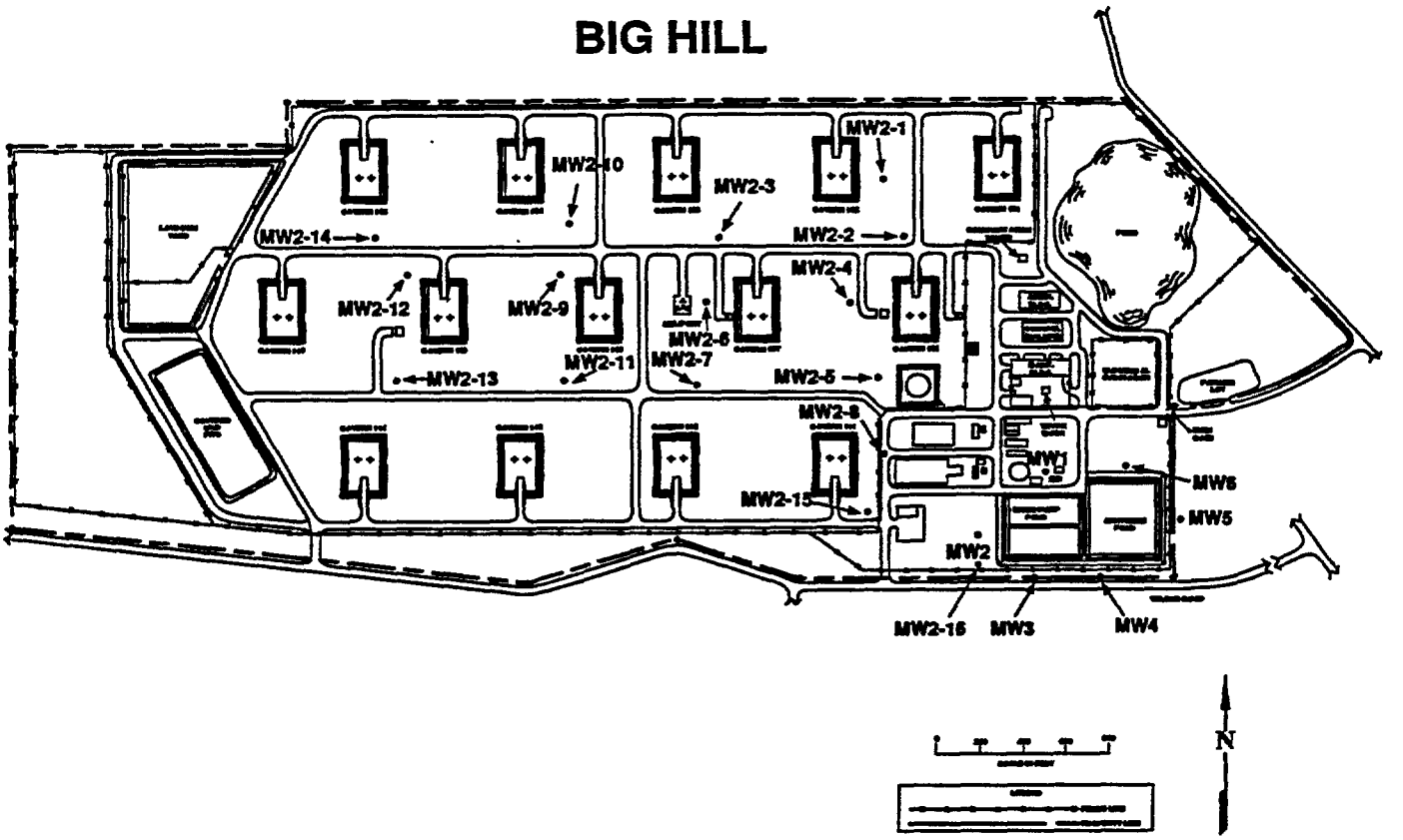
6.2 BIG HILL

The three major subsurface hydrological formations in the Big Hill area are the Chicot and Evangeline aquifers and the Burkville aquitard. The major source of fresh water is the Chicot Aquifer which is compressed 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 -30 m (-98 ft) mean sea level.

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

Sampling of six monitoring wells (wells MW1 to MW6) around the brine disposal pond system (Figure 6-2) began in September 1987. The pond system is composed of a Hypalon lined pond with an underdrain contained within a slurry wall. Salinity data collected from the six wells for the past four years indicate a consistency among them. Salinity of ground water from five wells remained 0 throughout 1991. A maximum 0.5 ppt salinity was observed at Well MW5, but overall, ground water exhibited a 0.2 ppt decrease from 1990. Well MW5 is downgradient of the brine pond and should intercept brine leakage past the slurry wall, but data are presently insufficient to indicate contamination. Monitoring of these wells will continue so that trends can be developed.

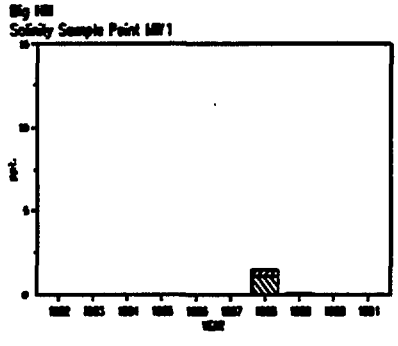
Monthly sampling of 16 2-inch brine pipeline monitoring wells (wells MW2-1 to MW2-16) began in 1991. Unlike those around the brine pond, these smaller wells were installed adjacent to buried brine pipelines on site to detect brine leaks (Figure 6-2).

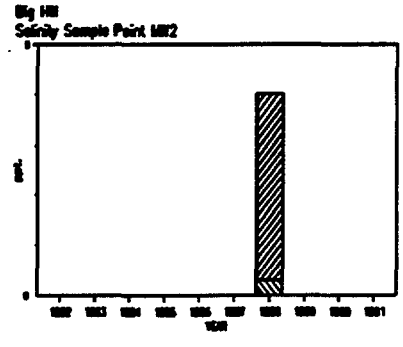


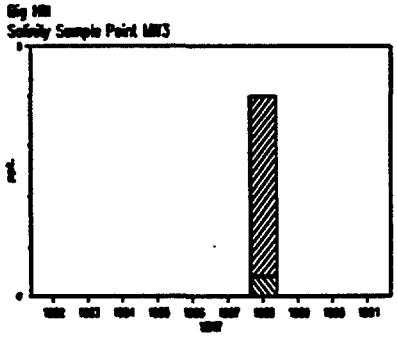
3348/FG/ENV/J/B.H. MAP/6-91

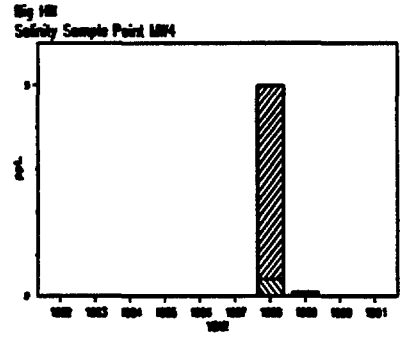
Figure 6-2.
Big Hill Ground water and Brine Pond Monitoring Wells

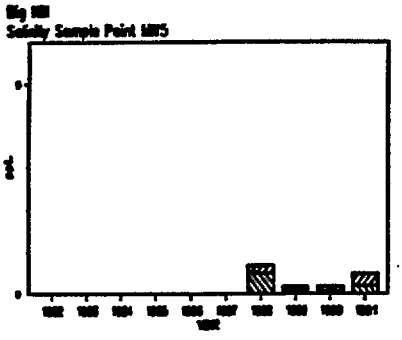
The wells are roughly 15 feet deep and do not intercept an aquifer. As a result, several remained dry and the remainder yielded very little water. Salinities at 15 of the wells ranged from 0 to 3.5 ppt, with most monthly readings remaining below 2.0 ppt. Only ground water from well MW2-15, east of Cavern 111, yielded salinities of 9.0 to 14.0 ppt. Elevated salinities in the clay are attributed to a past pipeline failure adjacent to that location.

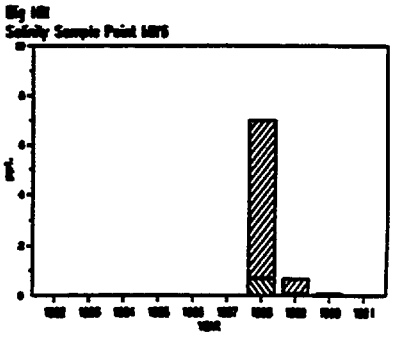












6.3 BRYAN MOUND

The Chicot and Evangeline Aquifers are fresh to slightly saline in the Bryan Mound area. Fresh water for Brazoria County is obtained from the upper portions of the Chicot Aquifer. No fresh water has been found over the salt dome. Monitoring well salinities ranged from 0.2 to 142 ppt.

Fifteen monitoring wells were drilled at Bryan Mound (Figure 6-3). Wells PZ1S, PZ2S, and PZ3S were installed in 1981. Sampling of wells PZ2S and PZ3S began in 1981, followed by that of PZ2S in 1983. Installation and sampling of two additional monitoring wells, BP1S and BP2S began in December of 1988. Three monitoring wells (MW1S, MW2S, and MW3S) were installed in August of 1989 and seven more (MW1D, MW2D, MW4D, PZ1D, BP1D, MW4S, and MW5S) were installed in 1990. Wells BP2S and PZ2S are presently out of service due to casing damage.

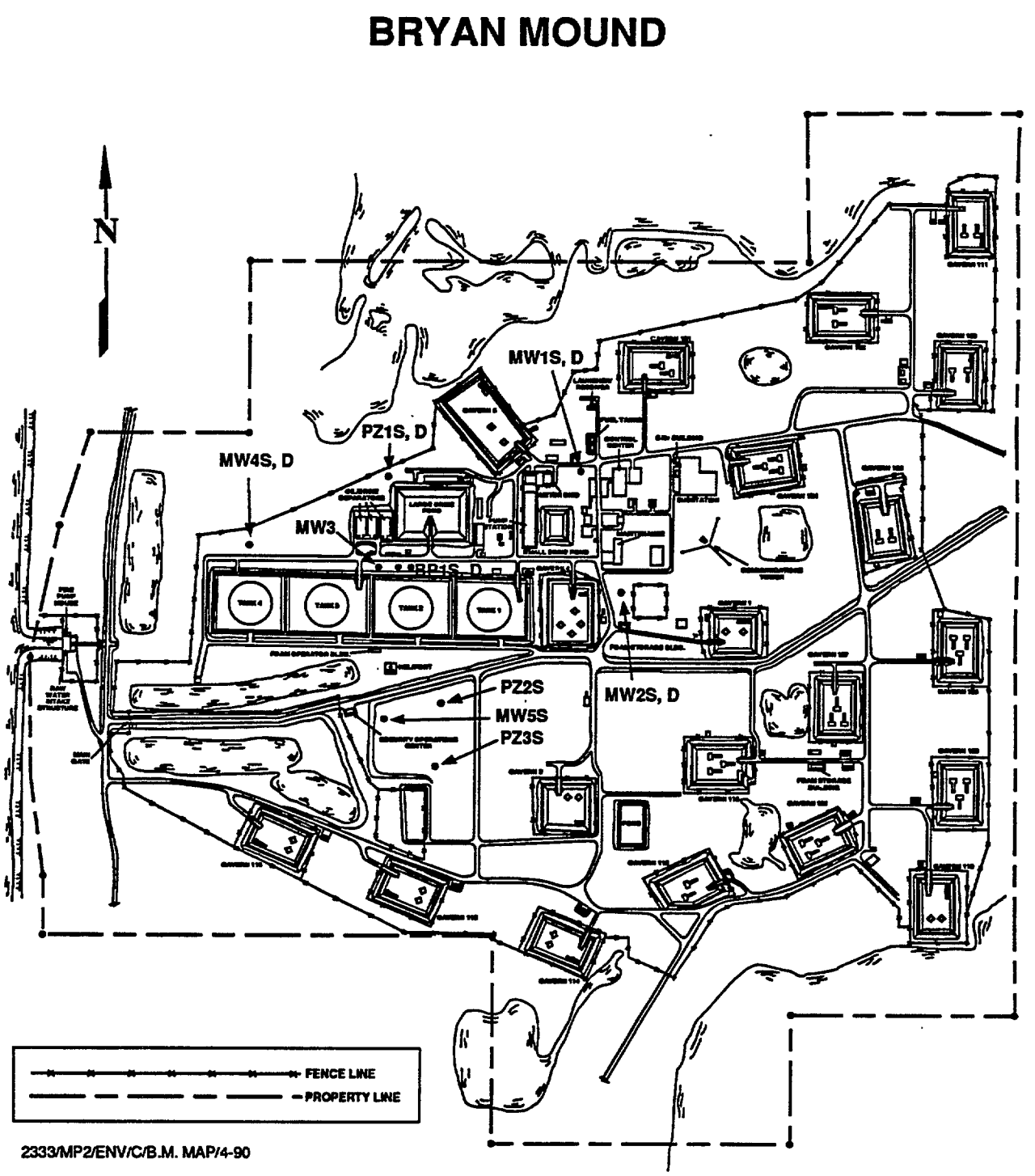


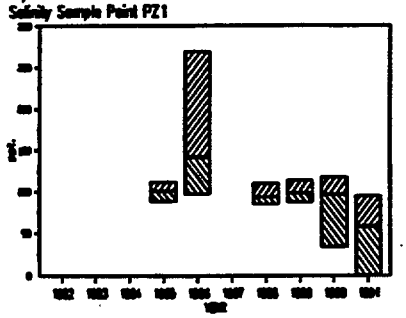
Figure 6-3. Bryan Mound Groundwater Monitoring Wells

Salinities of monitor wells PZ1S, MW1S, and BP1S have been high since installation. The origin of this high salinity is not yet known; however, it may be due to a large brine pond constructed with a Hypalon flexible membrane in 1978. The membrane was an impermeable 36 mil chlorosulfonated polyethylene liner commonly used in ponds. Despite the liner, the pond was known to have leaked. The pond was renovated with Hypalon and concrete in 1982 and in use today possibly leaks. High salinity could also be attributed to leakage from buried piping adjacent to the pond. Monitor well MW3S near the southwest corner of the brine pond, MW2S near the maintenance shop/laydown area, and PZ3S south of the tank farm, exhibit lower salinity which indicates they fall outside of the brine plume.

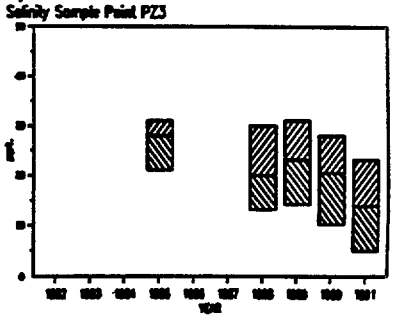
In 1991, a decrease in salinity was observed at the high salinity wells around the brine pond and well PZ3S, while a slight increase in salinity was observed at lower salinity wells MW2S and MW3S which may lie outside the contamination area. These changes do not reflect changes expected due to the general northwestward flow of ground water at that elevation. Observed ground water salinities may be related to the low transmissivity of the aquifer and surface clays (having an average linear ground water velocity of approximately 2.5 ft/yr, as determined by the 1991 Geraghty and Miller study) and the possible presence of other sources of brine contamination. More data and time are needed to accurately interpret well salinity changes.

The present brine pond and adjacent buried piping are tentatively scheduled for leak testing in 1994. Any pond and pipe leaks will be repaired in response to test results. A substantial drop in ground water salinity at the monitoring wells may not become evident for several years due to very limited ground water movement.

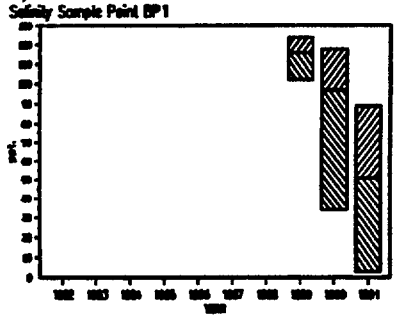
Bryan Mound
Salinity Sample Point PZ1



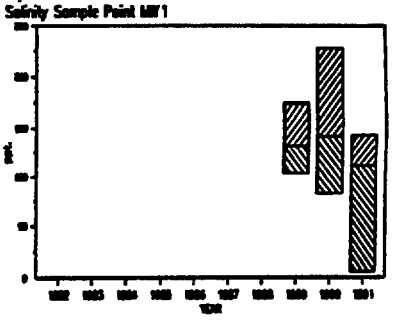
Bryan Mound
Salinity Sample Point PZ3



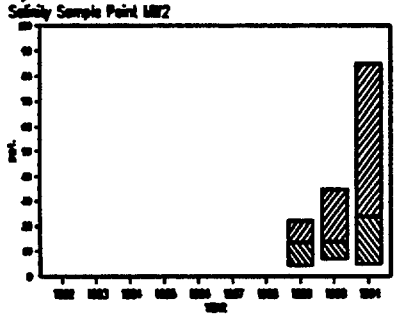
Bryan Mound
Salinity Sample Point BP1



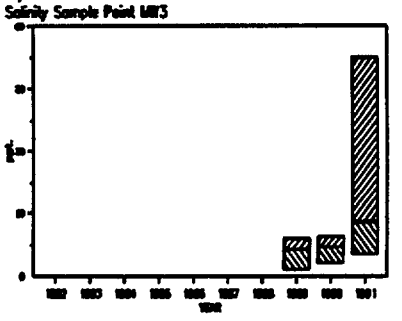
Bryan Mound
Salinity Sample Point MW1



Bryan Mound
Salinity Sample Point MW2



Bryan Mound
Salinity Sample Point MW3



6.4 ST. JAMES

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

No ground water monitoring wells have been installed at the St. James site due to the absence of brine and chronic crude oil spillage. There has been no evidence of leakage that would warrant a ground water study.

6.5 SULPHUR MINES

The main aquifers in the vicinity of Sulphur Mines are the Chicot, Evangeline, and Jasper. The Chicot Aquifer provides a fresh water source for public and industrial use to the towns of Hackberry, Lake Charles, and Sulphur. The Evangeline and Jasper aquifers are saline. The Evangeline Aquifer is used for salt water disposal in the Lake Charles area. No ground water monitoring wells were installed for brine or hydrocarbon contamination on the Sulphur Mines site.

6.6 WEEKS ISLAND

The Chicot formation is the principal aquifer in the Weeks Island area. The aquifer surface is approximately at sea level near Weeks Island and slopes slightly northwest towards a cone of depression attributed to heavy withdrawals in the Lake Charles area. The fresh water sand layers provide water for the local area.

There are no ground water monitoring wells at Weeks Island. There has been no evidence that site activities have compromised ground water integrity.

6.7 WEST HACKBERRY

There are three shallow aquifers found in the vicinity of the West Hackberry site. The Chicot Aquifer, which flows closest to the surface in the Hackberry area, contains predominantly fresh water with salinity increasing with proximity to the Gulf of Mexico. The Evangeline and Jasper aquifers flow under the Chicot and are saline.

The majority of the ground water pumping from the Chicot Aquifer takes place in the Lake Charles area. The pumping is so great that a cone of depression has been created which has reversed the flow direction to the north. The fresh/saline water interface is approximately 200 m (700 ft) below the surface.

There are 11 monitoring wells and 15 recovery wells (Figure 6-4) on the West Hackberry site. Three of the monitoring wells have been sampled since 1982. A fourth, well PB1, was plugged and abandoned in 1989. Eight wells were installed in 1988, two in 1989, five in 1990, and eight in 1991. Well logs and background information on construction and installation are lacking for wells installed prior to 1982, but are available for wells constructed later. All wells are used to monitor or control brine contamination, known to exist beneath the brine pond system.

Wells P1S and P3S were fitted with recovery pumps in 1989, and well P5S received a recovery pump in 1990. They have been pumped almost continuously since the pumps were installed for recovery of brine.

Compared to 1990 data, ground water salinity decreased slightly in 1991 at well P1S and substantially at well P5S, and increased at well P3S. Salinity trends for wells P1S and P5S are declining and increasing at well P3S; however, the monitoring period remains too brief to accurately assess trends.

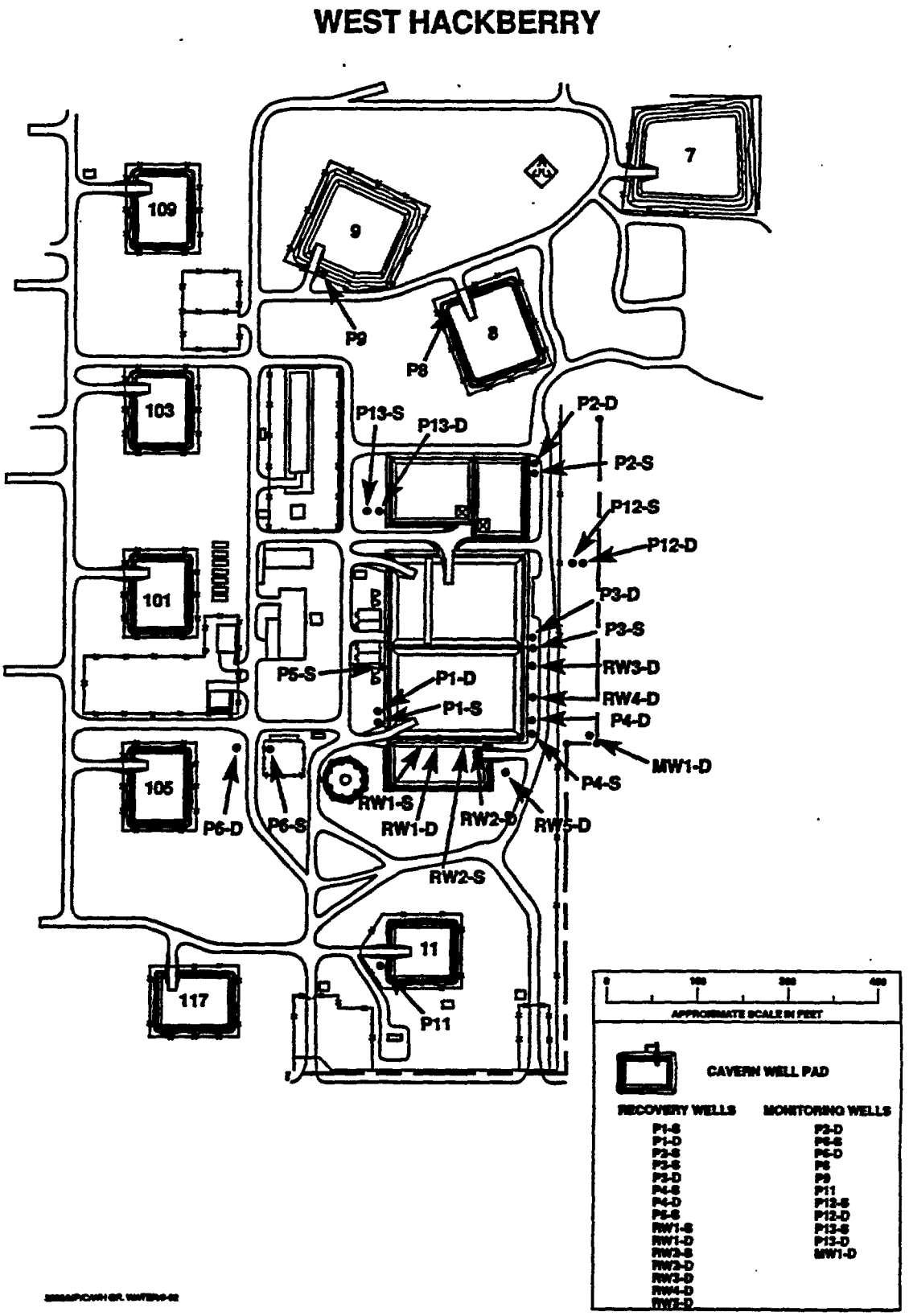
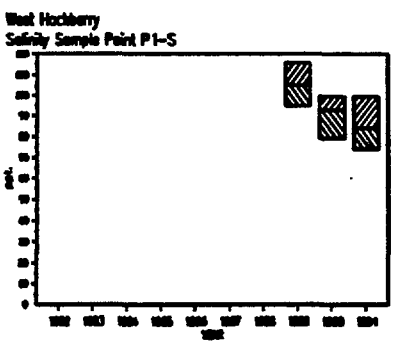
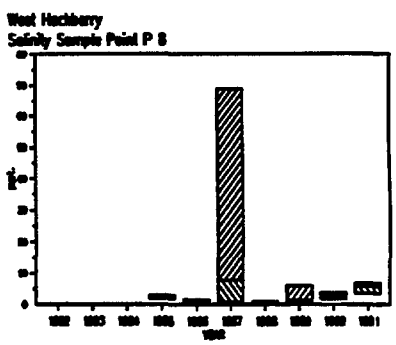


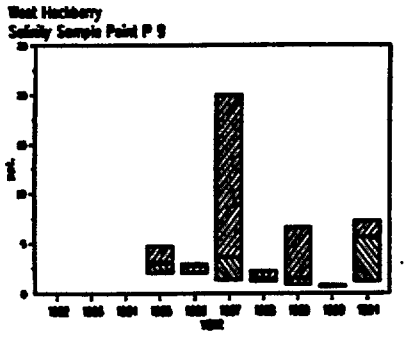
Figure 6-4 West Hackberry Groundwater Monitoring Wells

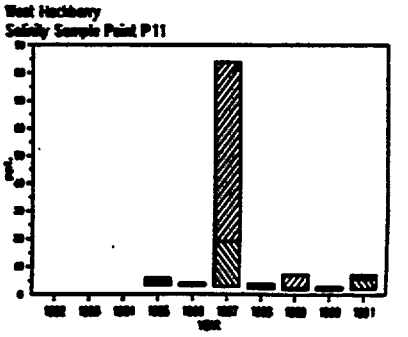
The 1991 ground water study identified the brine pond as the source of the brine plume. As a result, the brine pond was cleaned, cracks in the walls and floor were grouted to lessen the leak rate, and wells P1D, P2S, P3D, P4S, P4D, RW1S, RW1D, RW2S, RW2D, RW3D, RW4D, and RW5D were prepared for recovery service. Pumping of these wells and the current expansion of the ground water monitoring program will begin in 1992.

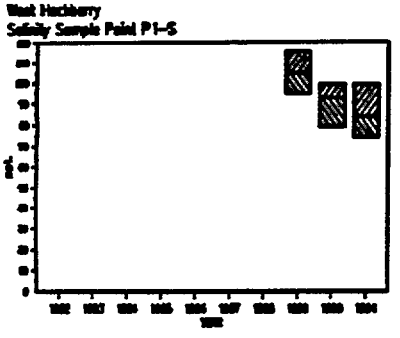
Sampling of monitoring wells P8, P9, and P11 continued in 1991. Although out of the vicinity of the brine pond ground water contamination plume, these wells, that represent ambient ground water conditions, showed roughly 5 ppt increases in salinity. The increases were consistent among all three wells, suggesting that a single point source of contamination is not the cause. Further sampling and testing, including the measuring of piezometric surfaces in all wells, will determine if this phenomenon is a trend or a cycle and locate sources of contamination if they exist.

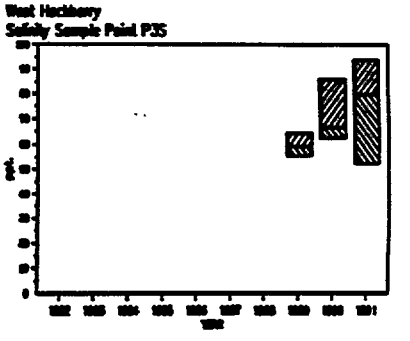


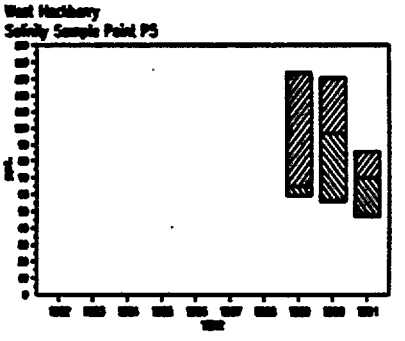



West Hackberry
Salinity Sample Point P 9


West Hackberry
Salinity Sample Point P11


West Hackberry
Salinity Sample Point P1-S


West Hackberry
Salinity Sample Point P3S


West Hackberry
Salinity Sample Point P5

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7. QUALITY ASSURANCE

The SPR sites undergo periodic evaluation throughout the year in the form of internal audits as well as audits by outside Federal and state agencies. The structured laboratory quality assurance program has continued through the systematic application of acceptable accuracy and precision criteria at SPR laboratories. Compliance with this and other environmental program requirements was reviewed and evaluated at each site by means of the M&O contractor's annual audits and audits at select sites by state and Federal environmental agencies.

7.1 FIELD QUALITY CONTROL

All field environmental monitoring and surveillance activities are performed in accordance with standard procedures contained in the BPS Environmental Programs and Procedures Manual. These procedures include maintenance of chain-of-custody, collection of quality control (QC) samples, and field documentation. BPS site operations personnel are routinely trained in the implementation of these procedures.

7.2 EPA DISCHARGE MONITORING REPORT QUALITY ASSURANCE STUDY

The EPA entered the eleventh year of its Discharge Monitoring Report Quality Assurance (DMR-QA) program. Through this program EPA ensures verifiable and consistent data generation by providing analytical laboratories of major NPDES dischargers blind samples of permit parameters for analysis. The Big Hill, Bryan Mound, and West Hackberry sites, classified as minor dischargers, participated in the study in 1991.

7.3 SPR LABORATORY ACCURACY AND PRECISION PROGRAM

The SPR laboratory quality assurance program is based on the U.S. EPA Handbook for Analytical Quality Control in Water and Waste Water Laboratories. This program focuses on the use of solvent or standard and method blanks, check standards, and for instrumental

methods, final calibration blanks and final calibration verification standards with each analytical batch to verify quality control. Additionally, replicate and spiked samples are analyzed at a 10% frequency to determine precision and accuracy, respectively. Analytical methodology is based on the procedures listed in Table 7.1. Several hundred of these quality assurance analyses were performed in addition to the 1991 discharge compliance analyses to verify the continuing high quality of SPR laboratory data.

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 or CV handheld computer to allow rapid and exact determinations of accuracy and precision without the necessity of quality control chart preparation. The listing below summarizes the QA data by site.

SITE	ACCURACY	PRECISION	# SAMPLES
BC	10.27	----	93
BC	-----	11.88	149
BH	30.12	-----	133
BH	-----	16.11	209
*BM	42.89	-----	24
BM	-----	30.35	37
WH	7.77	-----	206
WH	-----	39.09	103

* - Values for Oct. - Dec., 1991 only.

Table 7-1. SPR WASTEWATER LABORATORY ANALYTICAL METHODOLOGY

Analysis Determination	Method	Source*	Description
Biochemical Oxygen Demand	507 405.1	SM-16 EPA	5 Day, 20°C 5 Day, 20°C
Chemical Oxygen Demand	410.4	EPA	Colorimetric Manual
Fecal Coliform	909C	SM-16	Membrane Filter
Residual Chlorine	330.5	EPA	Spectrophotometric, DPD
Oil & Grease	413.1 503A	EPA SM-16	Separatory Funnel Extraction Partition - Gravimetric
Total Organic Carbon	415.1	EPA	Persulfate -
UV Oxidation	505B	SM-16	Persulfate - UV Oxidation
Dissolved Oxygen	360.1 360.2 421B 421F	EPA EPA SM-16 SM-16	Membrane Electrode (Field) Winkler Method (Lab) Winkler Method (Lab) Membrane Electrode (Field)
Hydrogen Ion Conc.	150.1 423	EPA SM-16	Electrometric Electrometric
Total Dissolved Solids	160.1 209B	EPA SM-16	Gravimetric, 180°C Gravimetric, 180°C
Total Suspended Solids	160.2 209C	EPA SM-16	Gravimetric, 103-105°C Gravimetric, 103-105°C

*EPA = U.S. Environmental Protection Agency, Methods for Chemical Analysis of Water and Waste, Document No EPA - 600/4-79-020, March 1983.

SM-16 = American Public Health Association, et al., Standard Methods for the Examination of Water and Wastewater, 16th Ed., 1985.

Standard Deviation is used to monitor changes in the accuracy and precision of specific analyses at specific sites. A Trend 7 analysis is applied to this Standard Deviation Data (per the EPA Handbook for Analytical Quality Control) to identify degradation of accuracy and precision. Identification of a trend 7 error, or a tendency towards this error, causes the chemist to examine procedures, instrumentation, and reagents for the source of error.

7.4 ENVIRONMENTAL AUDITS AND INSPECTIONS

In addition to Federal and state regulatory agency audits, the M&O contractor conducts an annual environmental audit at each site. Internal audits are conducted in accordance with a detailed audit checklist which addresses the pertinent aspects of all environmental programs and activities. Each audit is performed over a two to three-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 potential effects of planned and proposed site construction modifications.

The 1991 environmental audit at each SPR site revealed the overall implementation and execution of the SPR Environmental Program to be excellent.

Those areas noted needing improvement have generally been in missing reports, standardization, and recordkeeping. Specific corrective actions are tracked through completion.

Audits and inspections were conducted in 1991 by the EPA, COE, TACB, RCT, LDEQ, LDNR, and DOE. Findings reported during 1991 by those state and Federal regulatory agencies that performed

compliance inspections were generally consistent with SPR findings. The areas identified by regulatory agencies have all been resolved and are discussed in detail below. Such positive findings are attributed to the high level of environmental awareness exhibited among all site personnel and the emphasis SPR management has placed on fulfilling the intent and conditions of the SPR Environmental Program.

The LA DNR inspected the WH brine pond system and cavern well heads. No findings were expressed during the inspection

The RCT inspected the cleanup of Bryan Mound well pad 111. There was some concern with stained soil on the pad. Verbal agreement was reached on allowing photo and microbial degradation to proceed with continued water flushing. The RCT conducted a follow-up inspection and was satisfied with the results. No letter was issued on the inspection.

LDEQ conducted an air quality inspection of the St. James Terminal facility. Tank seal inspection records and one of the storage tanks were inspected for compliance. No written inspection report was prepared, and the inspectors stated that they had no findings.

The Weeks Island site was inspected by LDEQ. The auditors asked that analytical discharge data currently maintained at the Bayou Choctaw laboratory be maintained at Weeks Island. The requested file was established at Weeks Island.

The West Hackberry wastewater laboratory was inspected by LDEQ and found to be satisfactory.

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